

Introduction



This User Guide introduces the SAMA5D4 evaluation kit (SAMA5D4-EK) and describes the development and debugging capabilities for applications running on Atmel® | SMART SAMA5D4 ARM®-based embedded microprocessor units (eMPUs).

Kit Contents

Important: Unpack and inspect the kit carefully. Assemble the kit, following the assembly guide provided in the box. Contact your local Atmel® distributor if you have any issues concerning the contents of the kit.

The SAMA5D4-EK includes:

- Boards
 - One SAMA5D4X-MB main board
 - One 7" display module (TM7000)
- Cables
 - One micro-AB type USB cable
 - One RJ45 crossover cable
- Power supply
 - One universal input AC/DC power supply with US, Europe and UK plug adapters
 - One CR1225 3V lithium battery
- A Welcome Letter

Unpacked SAMA5D4-EK



Related Items

- Atmel SAMA5D4 Series Datasheet (<http://www.atmel.com>)
- PDA TM7000 Datasheet (<http://www.pdaatl.com>)

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1. Evaluation Kit Specifications

Table 1-1. Evaluation Kit Specifications

Characteristics	Specifications
Board	SAMA5D4X-MB
Board supply voltage	5V DC supply from an external AC-to-DC adapter or USB
Temperature: - Operating - Storage	0°C to +70°C -40°C to +85°C
Relative humidity	0 to 90% (non-condensing)
Dimensions: MB (Main Board) DM (Display Module)	165 x 135 mm 190 x 145 mm
RoHS status	Compliant
Kit Identification	MB: SAMA5D4X-MB DM: TM7000

1.1 Electrostatic Warning



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.

2. Power up

2.1 Power up the Board

Unpack the board, taking care to avoid electrostatic discharge. Unpack the power supply, select the power plug adapter corresponding to that of your country and insert it in the power supply.

Connect the power supply DC connector to the board and plug the power supply to an AC power plug.

The LCD should light up and display a welcome page. Then, click or touch the icons displayed on the screen and view the demo.

2.2 Sample Code and Technical Support

After booting up the board, you can run sample code or your own application on the evaluation 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. Evaluation Kit Hardware

3.1 Introduction

The SAMA5D4-EK is a fully-featured evaluation platform for Atmel SAMA5D44 ARM-based embedded microprocessor units (eMPU).

The evaluation kit allows users to extensively evaluate, prototype and create application-specific designs.

The SAMA5D4-EK is a new platform architecture based on a main board (MB) equipped with a SAMA5D44 device in BGA361 package and an optional display module (DM):

- The Main Board provides all the interface connectors required to attach the system to the application specific peripherals. This versatility allows the designer to create a densely-packed solution, which results in a more reliable product while simplifying system integration.
- The Display Module integrates a 7" LCD module (800x480 resolution), a maXTouch® capacitive touchscreen and capacitive Qtouch® buttons.

3.2 Main Board

3.2.1 Overview

The SAMA5D4X-MB is based on the integration of an ARM Cortex®-A5-based microprocessor with a set of standard peripherals. It is designed to provide a high-performance evaluation.

The SAMA5D4X-MB is built around the SAMA5D44 microprocessor available in 361-ball BGA package (16x16 mm body, pitch 0.8 mm.)

Figure 3-1. Main Board Top View

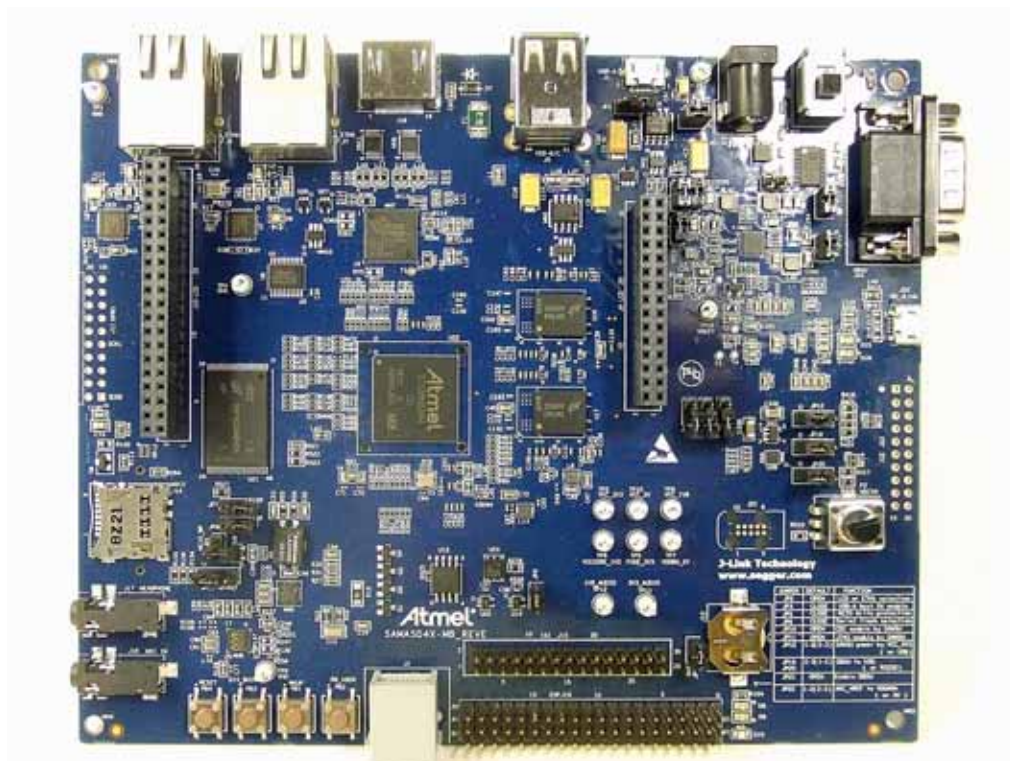


Figure 3-2. Main Board Layout

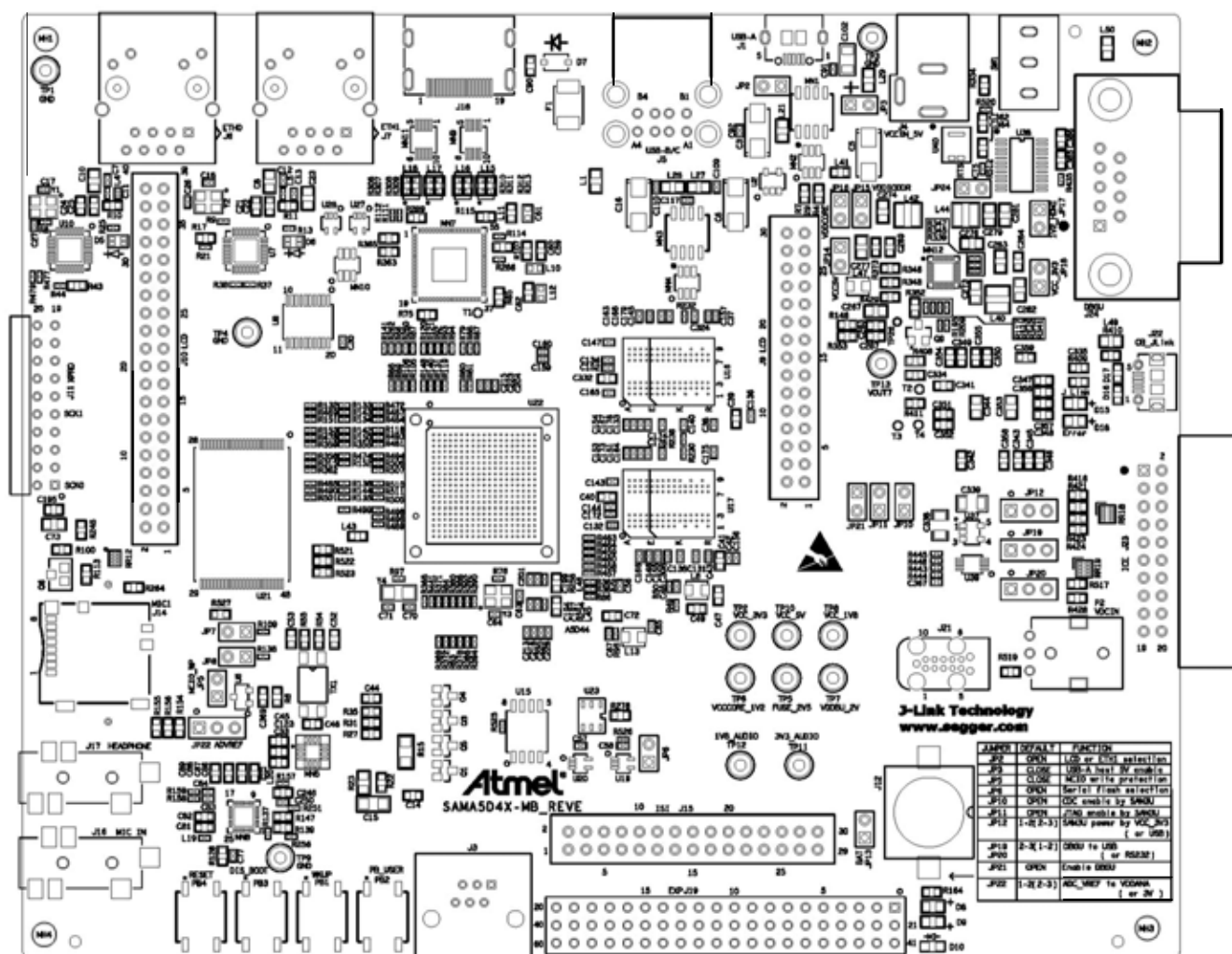
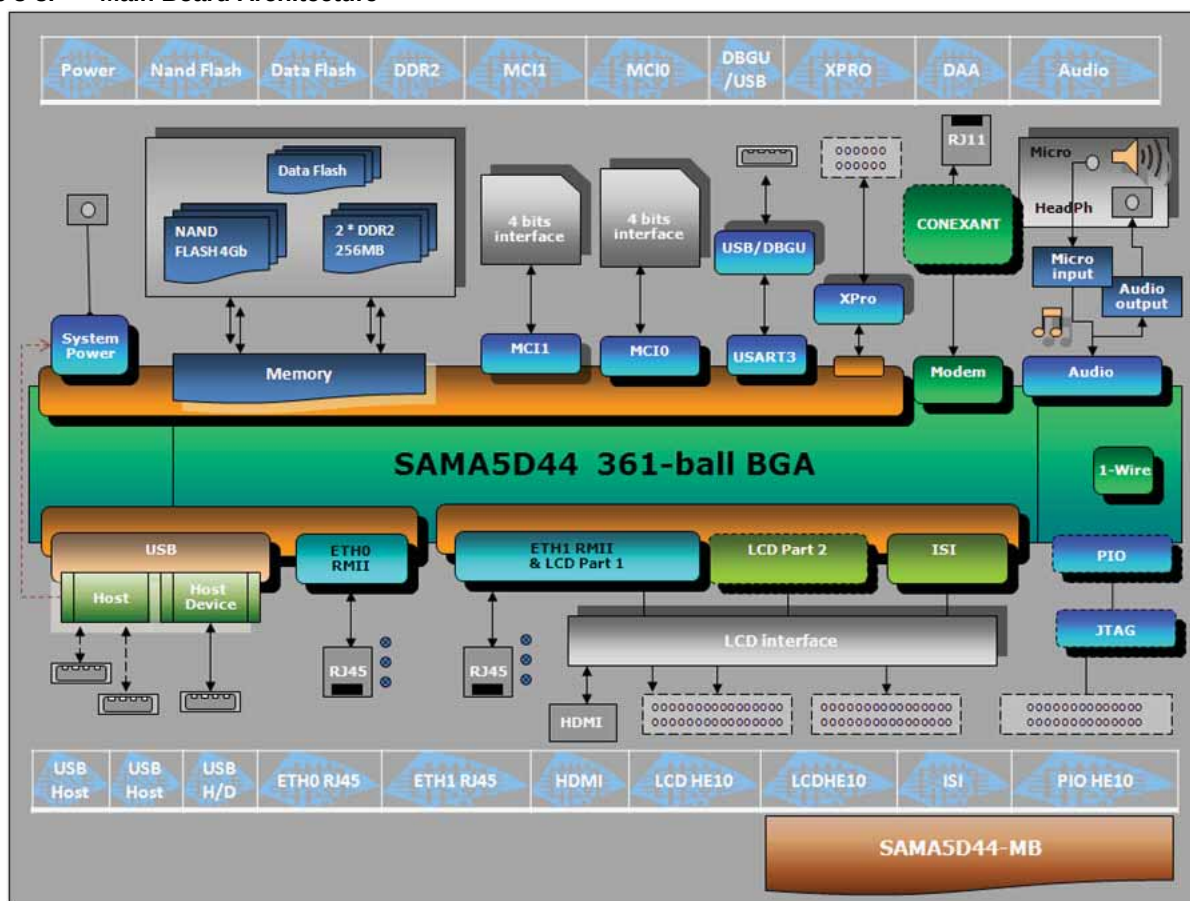


Figure 3-3. Main Board Architecture



3.2.2 Technical specifications

Table 3-1. SAMA5D4X-MB Specifications

Characteristics	Specifications
CPU	SAMA5D44: 361-ball BGA, 16x16 mm body, pitch 0.8 mm
Oscillator	12 MHz, 32 kHz, 25 MHz (PLLA @ 1.200 GHz, PCK @ 510 MHz, MCK @ 170 MHz)
Memory	4x 128 MB or 2x 256 MB DDR2 (800 MHz) 4Gb NAND Flash, Serial Flash
Debug support	JTAG connector Bridge USB-CDC / USART3
Power	5VDC external jack
Indicators	Red power LED Blue and green user LEDs

Table 3-1. SAMA5D4X-MB Specifications (Continued)

Characteristics	Specifications
Communication	Dual Host HS USB 2.0 port B&C Type A USB, 0.5 A with overcurrent limitation
	HS/FS USB 2.0 Host/Device port A Micro-AB USB, 0.5 A with overcurrent limitation
	Dual Ethernet 10/100 MHz, RJ45
	Soft-modem DAA
	Expansion interface
Audio	I2S, Line/Micro In and Heaphone output
Video interface	LCD 24 bits
	HDMI
	ISI
SD/MMC	MicroSD, 3.3V
	Standard 3.3V
User Interface	Mechanical push buttons
	3 LEDs
Expansion connectors	PIO
	LCD
	XPro
	ISI
Security	Mesh: one jumper between two consecutive PIOBU lines
	Switches: one jumper between one PIOBU line and GND
Temperature:	
– Operating	0° to +70° C
– Storage	0° to +70° C
Relative humidity	0 to 90% (non-condensing)
Dimensions	165 mm x 135 mm x 20 mm (L x W x H)
PCB	10 layers, Class5, FR4
RoHS status	Compliant

3.2.3 Main Features

- SAMA5D44 CPU with its embedded resources
 - 12 MHz, 32 kHz and 25 MHz oscillators
 - Power rails.
- Memory:
 - 4x 8-bit DDR2, 512 Mbytes (Micron MT47H128M8CF-25E)
 - 1x 8-bit NAND Flash, 512 Mbytes (Micron MT29F4G08ABAEAWP),
 - 1x Serial data Flash AT25DF321,
 - 2x SD/MMC interfaces with connector,
 - 1x 1-Wire DS28E05.
- Communication:
 - 2x USB host communication ports with power switch and current limitation,
 - 1x USB host/device with power switch and current limitation,
 - 1x ETH0 10/100MHz PHY RMII, KSZ8081RNL MICREL,
 - 1x ETH1 10/100MHz PHY RMII, KSZ8081RNL MICREL shared with LCD PIO,
 - 1x Soft-Modem DAA.
- LCD, Video, ISI:
 - 1x LCD 24-bit interface connector for LCD and QTouch,
 - 1x ISI connector,
 - 1x HDMI interface Si9022 Silicon Image with connector.
- Audio:
 - Line Input (or Micro) and Headphone output,
- Debug solution:
 - 1x peripheral Input/Output extension connector HE10 (PIO A to E),
 - 1x JTAG/ICE connector,
 - 1x DBGU/USB bridge device communication interface.
- Analog:
 - Analog reference,
 - Potentiometer connected on ADC input,
 - Power lines with jumpers for current measurement.
- Buttons:
 - Disable boot, reset and wakeup pushbuttons,
 - 1x user input push button.
- LEDs:
 - 1x red power LED,
 - 1x blue user LED,
 - 1x green user LED.

3.2.4 Board Interface Connections

The following connections are supported by the SAMA5D4X-MB:

- One JTAG, 20-pin IDC connector,
- USB, 5-pin Micro-AB connector,
- USB, 5-pin standard type A connector,
- One Micro SD card connector,

- One MMC card connector,
- Two Ethernet RJ45 connectors,
- One modem CONEXANT DAA CX20548 connected to an RJ11 connector,
- One optional right-angle male XplainedPro connector HE14, 2x10 pts (not mounted),
- One stereo jack for headphones/line output
- One stereo jack for microphone input,
- One TFT LCD display with TouchScreen female connector HE10 2x20 + 2x15 pts,
- One ISI connector HE10 female 2*15 pts,
- One HDMI connector,
- One 3x 20-pin PIO connector,
- Test points located throughout the board,
- One Lithium 12-mm Coin Cell Battery Holder (for backup battery socket),
- One Main power supply.

3.2.5 SAMA5D4 Series 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.

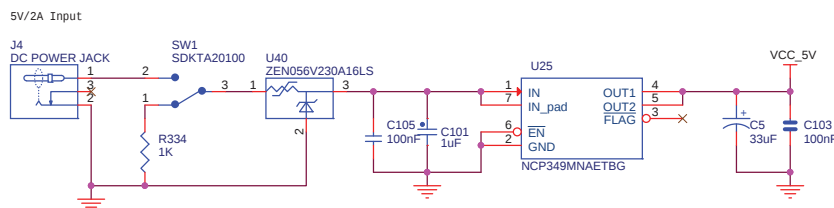
The SAMA5D4 series is optimized for control panel/HMI applications needing video playback and applications that require high levels of connectivity in the industrial and consumer market. Its security features make the SAMA5D4 well suited for secure gateways or for the IoT.

3.2.6 Power Supply

3.2.6.1 Powering up the Board

Main power can be supplied to the SAMA5D4X-MB using a +5V DC plug adapter:
5V DC power adapter connected to the 2.0 mm power supply jack.

Figure 3-4. 5V Power Supply



An NCP349 overvoltage device is available to prevent board damage in case an unsuitable power adapter is used. The NCP349 shuts down and the board does not power on. No visible indicator is provided to indicate that an overvoltage condition exists.

The board can also be powered from the USB port. A typical USB port is limited to 500 mA max.

3.2.7 Power Supply Topology and Power Distribution

3.2.7.1 Power Lines

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

3.2.7.2 Power-up and Power-down Considerations

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

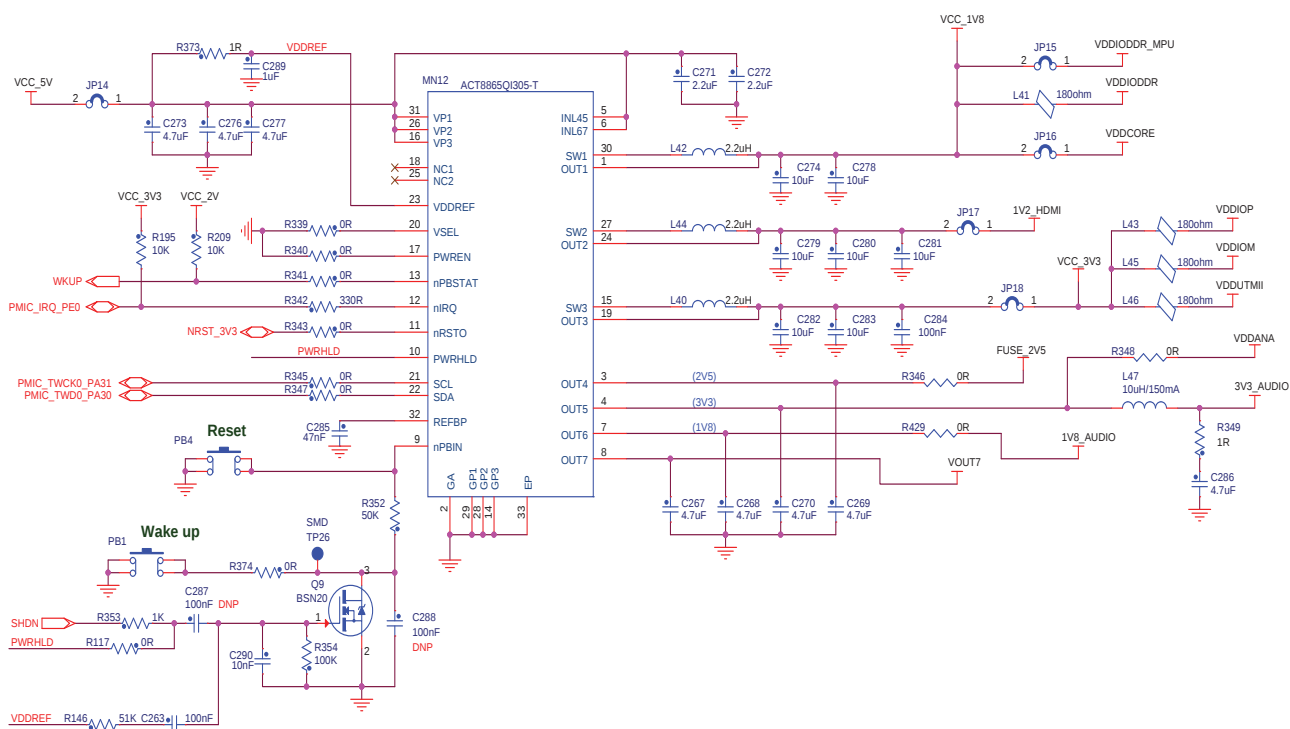
3.2.7.3 PMIC-ACT8865 power management solution

The ACT8865 is a complete, cost-effective, highly-efficient ActivePMU™ power management solution, optimized to provide a unique power solution and voltage sequencing for the 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.

Warning: Be aware of the I2C limitation related to the ACT8865.
See “Errata info” section in the ACT8865 Datasheet (<http://www.active-semi.com>).

Figure 3-5. Power Management



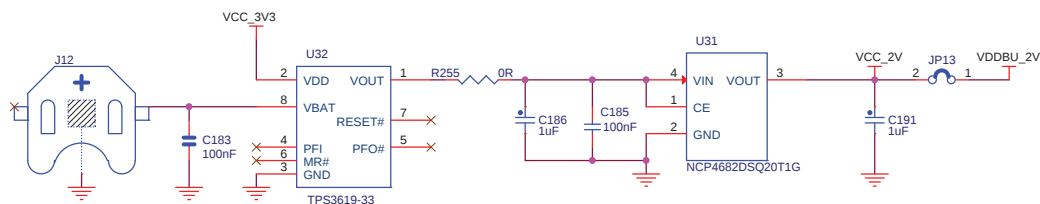
The ACT8865 provides:

- All power supplies required by the SAMA5D44 device,
 - 1.8V VDDCORE
 - 1.8V VDDIOP
 - 2.0V VDDBU
 - 3.3V VDDIOP, VDDOSC, VDDIOM, VDDANA, VDDUTMI
 - 2.5V VDDFUSE
- Power supplies to external chips on the main board.
 - 1.2V HDMI
 - 1.8V Memory, Audio codec
 - 3.3V Memory, Audio codec, Ethernet PHY, HDMI, SAM3U

3.2.7.4 Backup Power Supply

The SAMA5D4X-MB requires a battery (3V Lithium Battery type CR1225 or equivalent) in order to permanently power the backup part of the SAMA5D44 device.

Figure 3-6. VDDBU



3.2.7.5 Power Supply Control

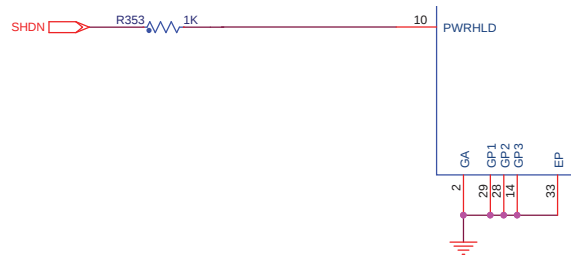
In the ACT8865, three DCDCs (1.8V, 1.2V, 3.3V) and two LDOs outputs are available.

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

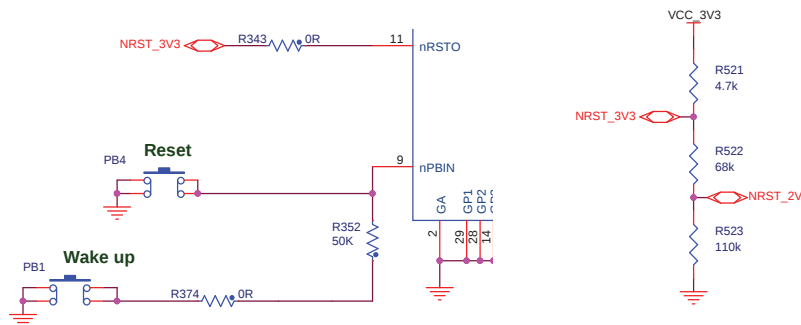
Figure 3-7. SHDN Control



Two pushbuttons are also available:

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

Figure 3-8. Reset/Wakeup



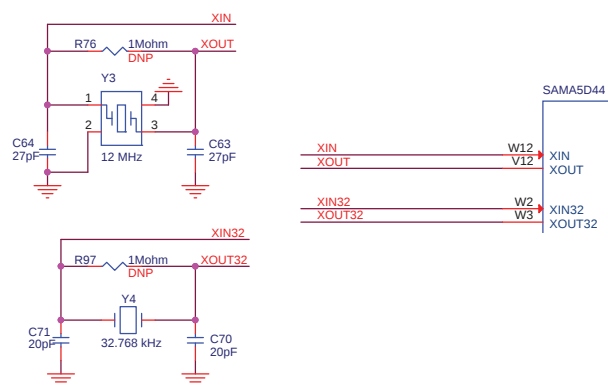
3.2.8 Microcontroller Resources

3.2.8.1 Clock Source

The microcontroller requires two clock sources:

- 32.768 kHz crystal for slow clock oscillator input and embedded RTC
- 12 MHz main crystal oscillator

Figure 3-9. Clock Generator

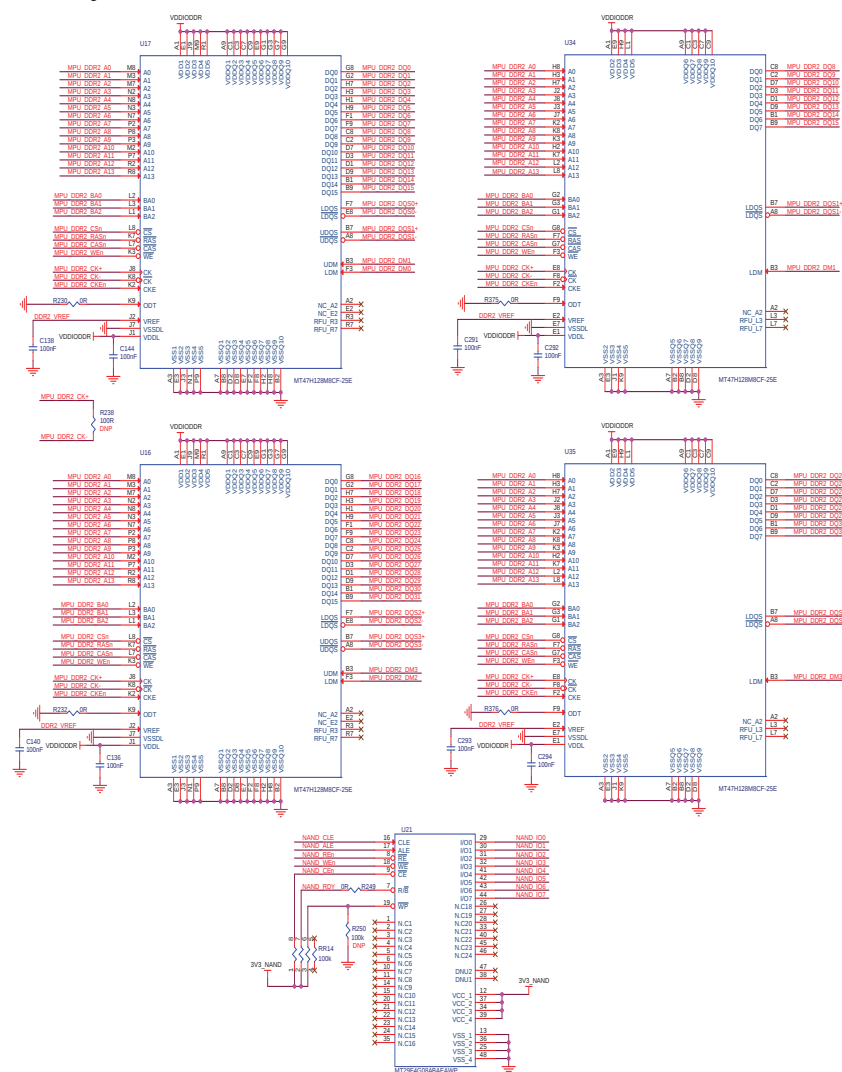


3.2.9 Memory

The SAMA5D4X-MB is equipped with three types of memory devices:

- Four DDR2 1.8V 1Gbit, 8 banks, 4x8 bits data interface connected to DDR-D[0-31]
or
two DDR2 1.8V 2Gbit, 8 banks, 2x16 bits data interface connected to DDR-D[0-31],
- One SLC NAND Flash 3.3V 4Gbit, TSOP or BGA, 8-bit data interface connected to D[0-7]. NAND Flash compatible with Open NAND Flash Interface Specification (ONFI 2.0 min).

Figure 3-10. External Memory



3.2.9.1 DDR_CALP and DDR_CALN analog inputs

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



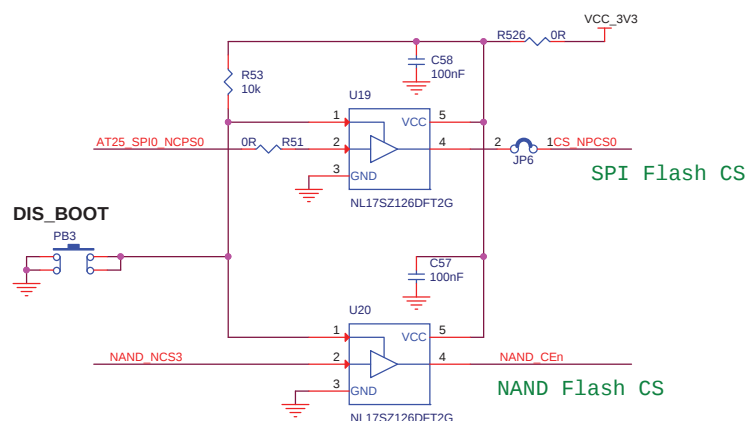
Table 3-2. DDR_CALN & DDR_CALP

	CALP pull-down	CALN pull-up
DDR2	200R	200R
LPDDR2	240R	240R

3.2.9.2 Boot Memories

A mechanical pushbutton embedded on the board disables the signal selection (CS#) of the bootable memory components (NAND Flash and Serial DataFlash) using a non-inverting 3-state buffer.

Figure 3-11. CS Disable



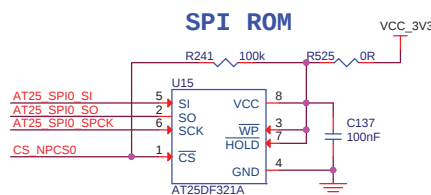
The device can boot from:

- an SD CARD connected on MCI1
- a Dataflash connected on NPCS0 SPI0
- an 8-Bit NandFlash connected to D0-D7

3.2.9.3 SPI Serial Flash

The SAMA5D4X-MB embeds one serial Flash AT25DF321A.

Figure 3-12. Serial Flash on SPI0



3.2.10 High-Speed Multimedia Card Interface (HSMCI)

3.2.10.1 High-Speed Card Interfaces (MCI)

The SAMA5D4X-MB 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:

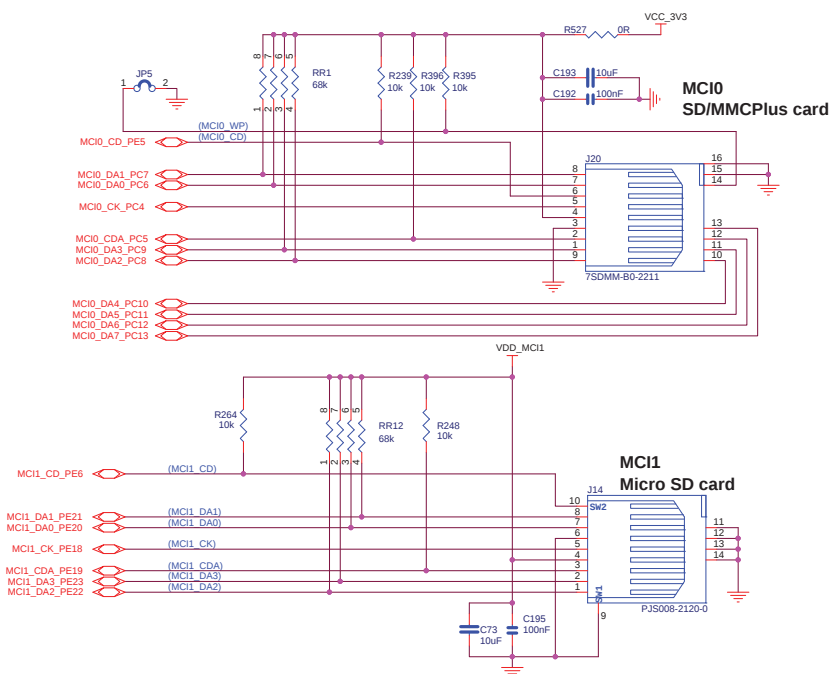
- **MCI0 interface.** It is based on an 11-pin interface (clock, command, 8-bit data, power lines).
- **MCI1 Interface.** It is based on a 7-pin interface (clock, command, 4-bit data, power lines).

3.2.10.2 HSMCI Card Connector

A standard MMC/SD card (push and click type) connector, connected to MCI0, is available on the top of the board. It features a top mount, a push-lock / push-eject mechanism and a card detection switch.

A micro SD card (push and click type) connector, connected to MCI1, is available on the top of the board. It features a bottom mount and a card detection switch.

Figure 3-13. HSMCI0 & HSMCI1

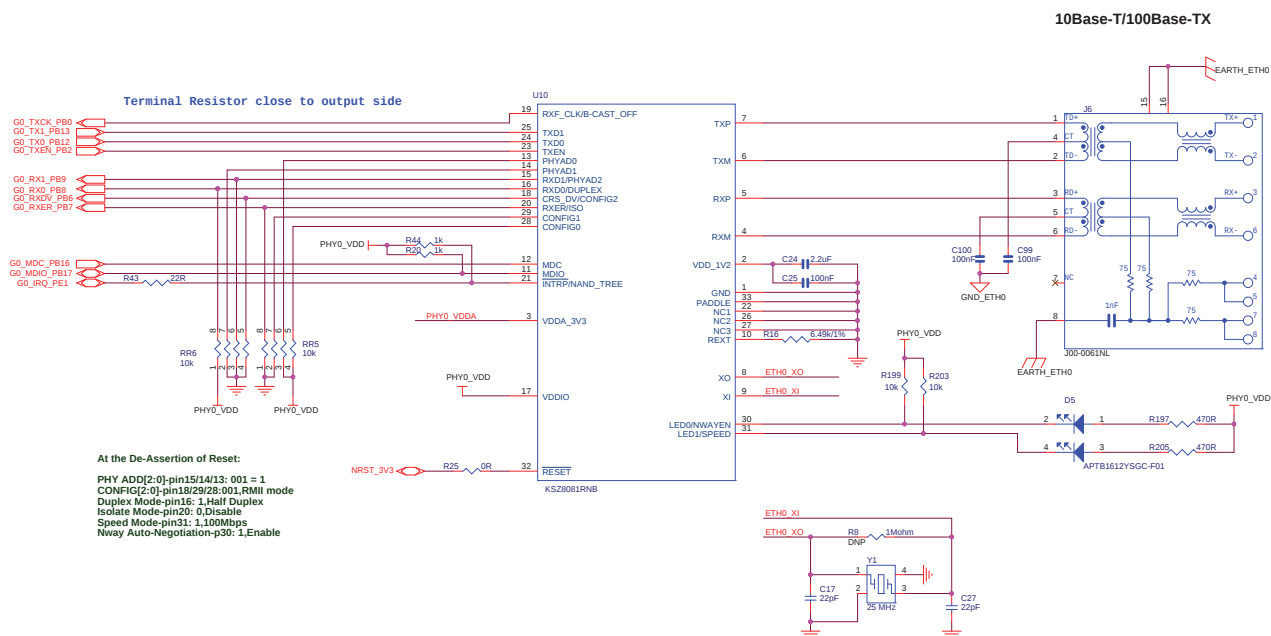


3.2.11 Communication Interfaces

The SAMA5D4X-MB is equipped with the following communication interfaces.

3.2.11.1 Ethernet ETH0 (PHY:KSZ8081RNL MICREL)

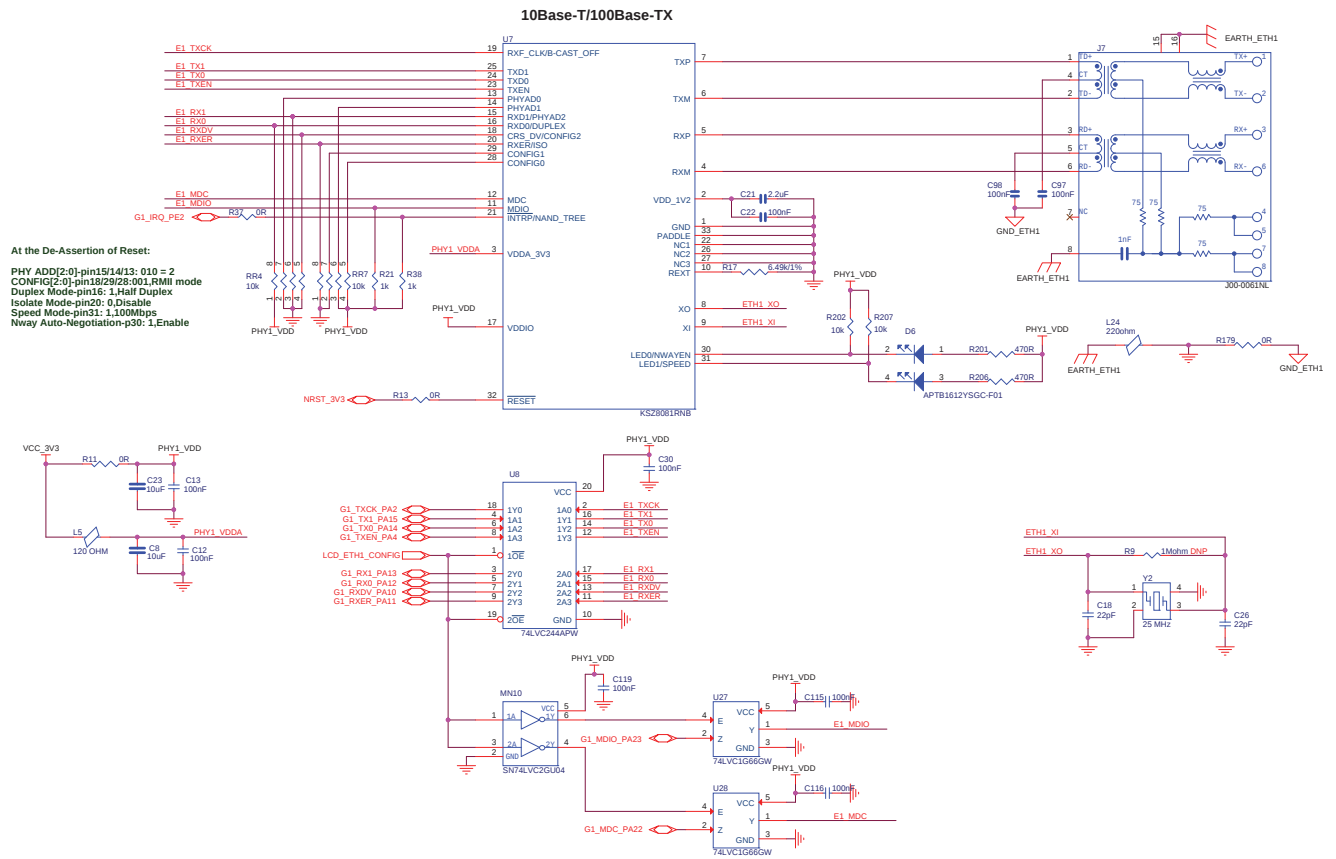
Figure 3-14. ETH0 Interface



3.2.11.2 Ethernet ETH1 (PHY: KSZ8081RNL MICREL)

The ETH1 control bus is multiplexed with the LCD. Consequently, the tri-state bus transceivers 74LVC244 and 74LVC1G66 have been added.

Figure 3-15. ETH1 Interface



Note: Port A is shared between LCD and ETH1. To use ETH1, jumper JP2 must be in place.

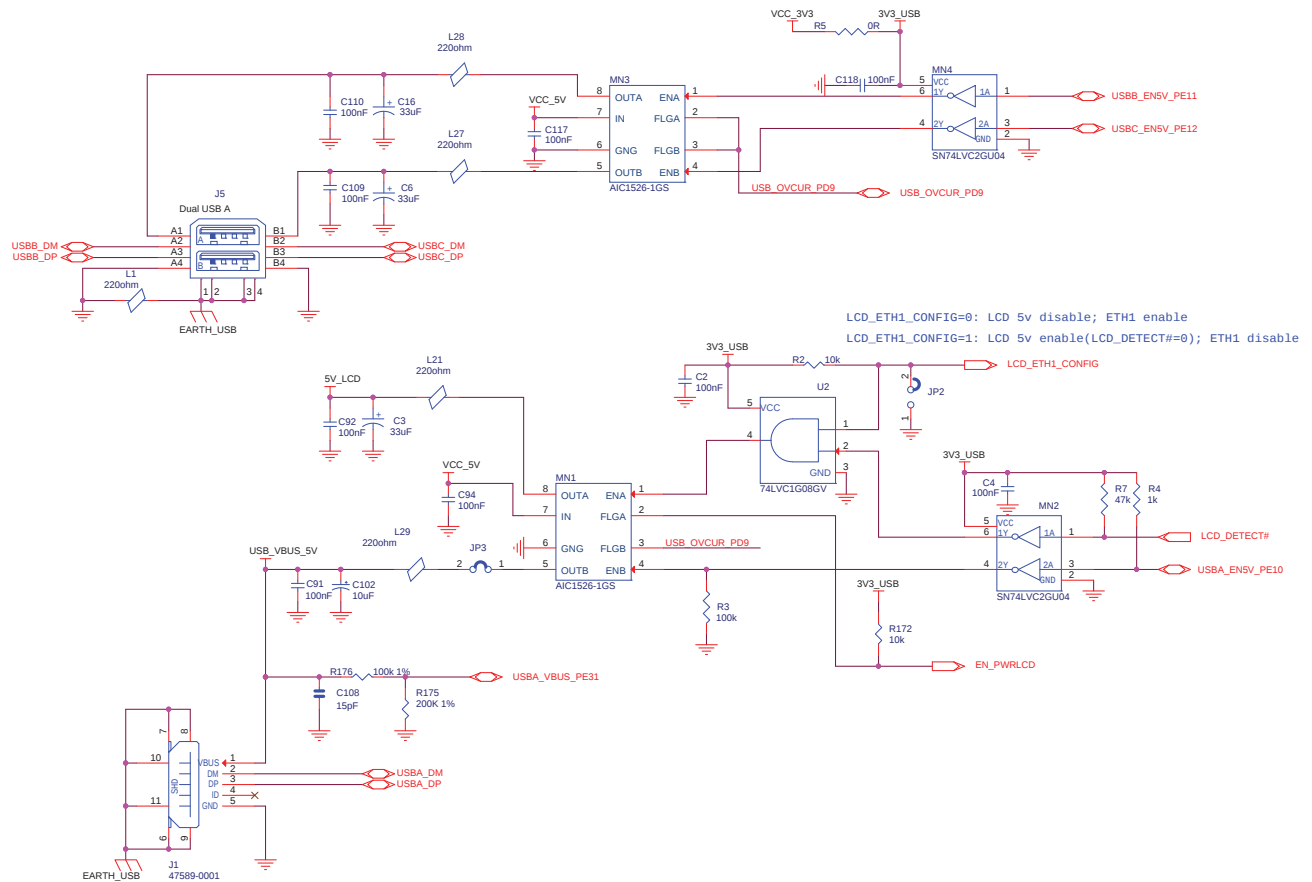
3.2.11.3 USB Host B/C High & Full Speed Interface

- Two USB host stacked type A connectors.

3.2.11.4 USB Host /Device A Interface

- One USB device standard micro-AB connector.

Figure 3-16. USB Host & Device Interface



3.2.12 Debug JTAG/ICE and DBGU interfaces

The MB includes a built-in SEGGER J-Link-on-Board device. The J-Link functionality is implemented with an ATSAM3U4C microcontroller in LQFP100 package.

The ATSAM3U4C provides JTAG functions and a bridge USB/Serial DBGU port.

Two LEDs (D15 and D18) that are mounted on the main board signal the status of the J-Link-on-Board device.

The J-Link-OB-ATSAM3U4C is designed to provide an efficient on-board alternative to the standard J-Link.

An optional 20-pin header is provided on the board to allow for the JTAG connection. To use this functionality, the JP11 jumper must be in place.

Jumper JP11 disables the J-Link-OB-ATSAM3U4C JTAG functionality.

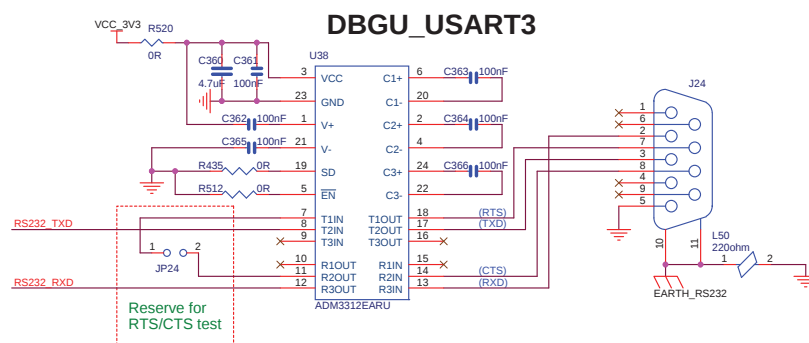
- Note: Jumper JP11 only disables the JTAG controller inside the JLINK-OB. The debug serial port (DBGU) remains operational.

3.2.12.2 Hardware UART via CDC

This feature is enabled only if Pin 24 of the microcontroller is not tied to ground. The pin is normally pulled high and controlled by jumper JP10.

- ### 3.2.12.3 Hardware DBGU

21



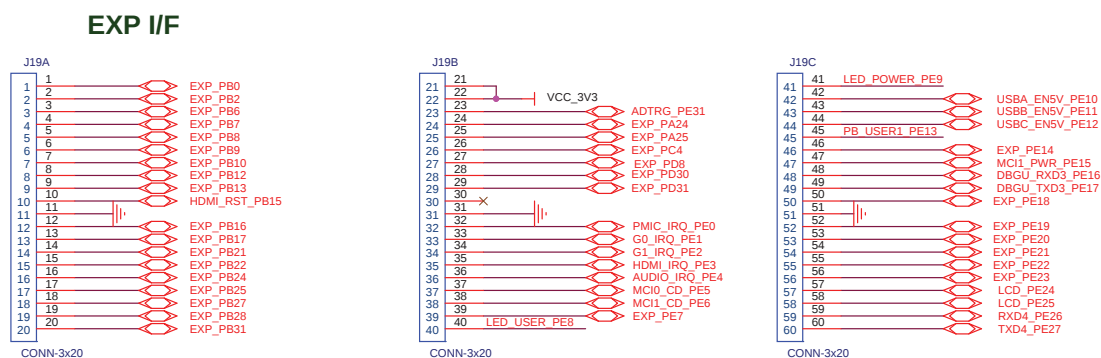
- Jumper JP19 and JP20 1-2 pins: Hardware DBGU is enabled
- Jumper JP19 and JP20 2-3 pins: CDC is enabled (default status)

3.2.13 Expansion Ports

3.2.13.1 I/O Expansion Interface

One 60-pin header (J19) is provided on the board to allow for the PIO connection of various expansion cards. Due to multiplexing, different signals can be routed to each pin.

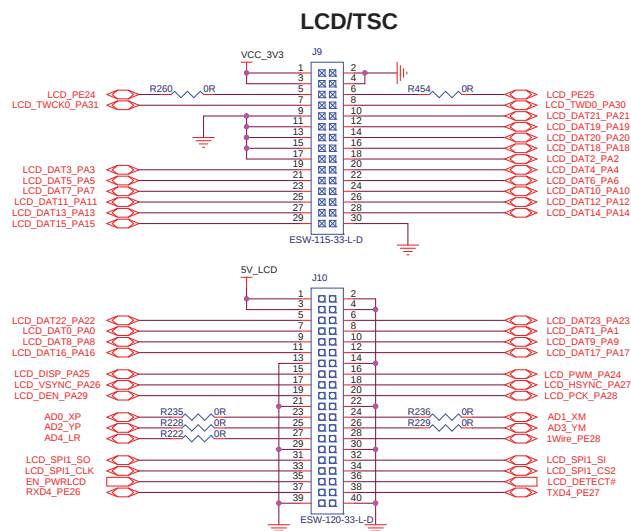
Figure 3-19. I/O Expansion



3.2.13.2 LCD Interface

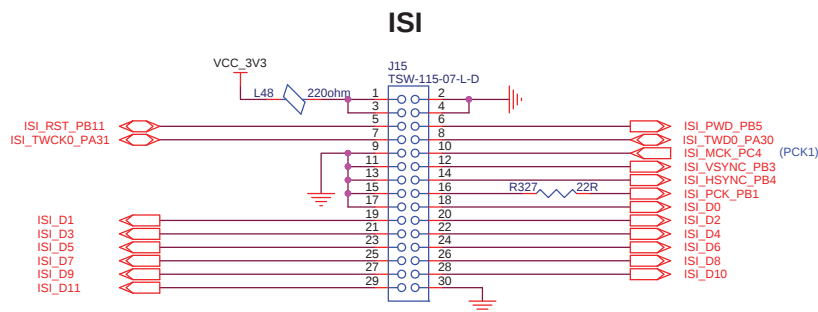
Two connectors (J9, J10) are provided on the board to interface the LCD and the touchscreen module.

Figure 3-20. LCD Expansion



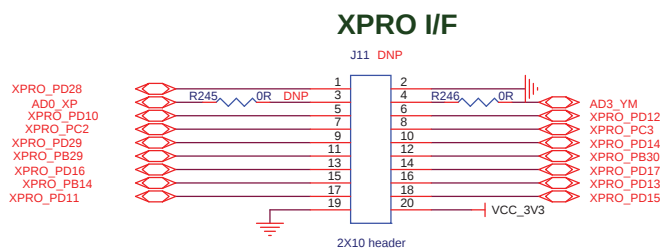
3.2.13.3 ISI Interface

Figure 3-21. ISI Expansion



3.2.13.4 XPro Interface

Figure 3-22. XPro Expansion



3.2.14 CONEXANT DAA CX20548 Interface

The SAMA5D4X-MB features a smart DAA chip to drive an analog telephone line on RJ11 6P4C port (J13).

The SAMA5D4X-MB includes a WOLFSON WM8904 CODEC for input and output of digital sound. This interface includes audio jacks for MIC input (J16) and Headphone line output (J17).

The SAMA5D4-MB provides three on-board connectors to connect:

- a display module with capacitive touchscreen and QTouch (TM7000),
- an ISI module

3.2.16.1 LCD Connector J9

Table 3-3. HE10 Female LCD 2x15pts

LCD		Pin Number		LCD	
VDD3V3		1	2	GND	
VDD3V3		3	4	GND	
-		5	6	-	
TWCK0		7	8	TWD0	
GND		9	10	LCDDAT21	
GND		11	12	LCDDAT19	
GND		13	14	LCDDAT20	
GND		15	16	LCDDAT18	
GND		17	18	LCDDAT2	
LCDDAT3		19	20	LCDDAT4	
LCDDAT5		21	22	LCDDAT6	
LCDDAT7		23	24	LCDDAT10	
LCDDAT11		25	26	LCDDAT12	
LCDDAT13		27	28	LCDDAT14	
LCDDAT15		29	30	GND	

3.2.16.2 LCD/TSC Connector J10

Table 3-4. HE10 Female LCD/TSC 2x20 pts

LCD		Pin Number		LCD	
5V	5V_LCD	1	2	GND	GND
5V	5V_LCD	3	4	GND	GND
LCDDAT22	-	5	6	-	LCDDAT23
LCDDAT0	-	7	8	-	LCDDAT1
LCDDAT8	-	9	10	-	LCDDAT9
LCDDAT16	-	11	12	-	LCDDAT17
GND	GND	13	14	GND	GND
LCDDISP	-	15	16	-	LCDPWM
LCDCSYNC	-	17	18	-	LCDHSYNC
LCDDEN	-	19	20	-	LCDPCK
GND	GND	21	22	GND	GND
AD0_XP	TSC	23	24	TSC	AD1_XM
AD2_YP	TSC	25	26	TSC	AD3_YM
AD4_LR	TSC	27	28	-	1-WIRE
GND	GND	29	30	GND	GND
SPI1_MISO	-	31	32	-	SPI1_MOSI
SPI1_SPCK	-	33	34	-	SPI1_NPCS0

Table 3-4. HE10 Female LCD/TSC 2x20 pts (Continued)

LCD		Pin Number		LCD	
EN_PWRLCD	-	35	36	LCD_DETECT	LCD_DETECT#
-	-	37	38	-	-
GND	GND	39	40	GND	GND

3.2.16.3 ISI Connector J15

Table 3-5. HE10 Female ISI 2x15 pts

ISI	Pin Number		ISI
VDDISI	1	2	GND
VDDISI	3	4	GND
ISI_RST	5	6	ISI_PWD
TWCK0	7	8	TWD0
GND	9	10	ISI_MCK
GND	11	12	ISI_VSYNC
GND	13	14	ISI_HSYNC
GND	15	16	ISI_PCK
GND	17	18	ISI_D0
ISI_D1	19	20	ISI_D2
ISI_D3	21	22	ISI_D4
ISI_D5	23	24	ISI_D6
ISI_D7	25	26	ISI_D8
ISI_D9	27	28	ISI_D10
ISI_D11	29	30	GND

3.2.16.4 HDMI Transmitter Interface (SiI9022ACUN)

Compliance:

- HDMI 1.2a, Simply HD, DVI 1.0

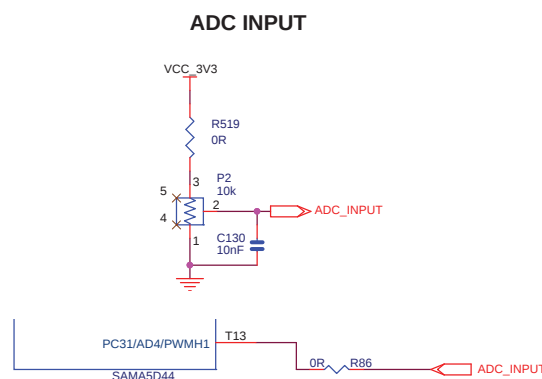
Digital Video Output:

- 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
 - 12/24-bit RGB YCbCr 4:4:4
 - 16/20/24-bit YCbCr 4:2:2
 - 8/10/12-bit YCbCr 4:2:2 (ITU-R BT.601 & BT.656)
- Integrated YCbCr to RGB conversion
- 4:2:2 to 4:4:4 up-converter

Digital Audio Output:

- DVD-Audio support through four I2S inputs
- Supports 2-channel 192 kHz or 8-channel 96 kHz

Figure 3-27. Analog Input



3.2.18 1-Wire EEPROM (DS28EC20)

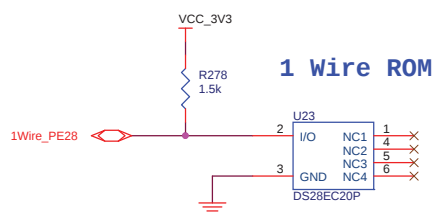
The SAMA5D4X-MB uses a 1-wire device as a “soft label” to store information such as chip type, manufacturer name, production date, etc.

The DS28EC20 is a 20480-bit 1-Wire® EEPROM. It is organized as 80 memory pages of 256 bits each. An additional page is set aside for control functions. Data is written to a 32-byte scratchpad, verified, and then copied to the EEPROM memory.

As a special feature, blocks of eight memory pages can be write protected or put in EPROM-Emulation mode, where bits can only be changed from a 1 to a 0 state. The DS28EC20 communicates over the single-conductor 1-Wire bus.

The communication follows the standard 1-Wire protocol. Each device has its own unalterable and unique 64-bit ROM registration number that is factory-lasered into the chip. The registration number is used to address the device in a multidrop 1-Wire net environment.

Figure 3-28. 1-Wire EEPROM



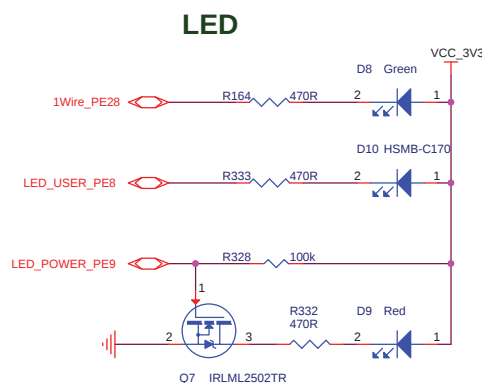
3.2.19 Miscellaneous IO

3.2.19.1 Discrete LEDs

Indicators on the main board include discrete LEDs:

- One blue LED connected to a PIO
- One green LED connected to a PIO (shared with the 1-wire)
- One power red LED connected to a MOS.

Figure 3-29. Debug Discrete LEDs

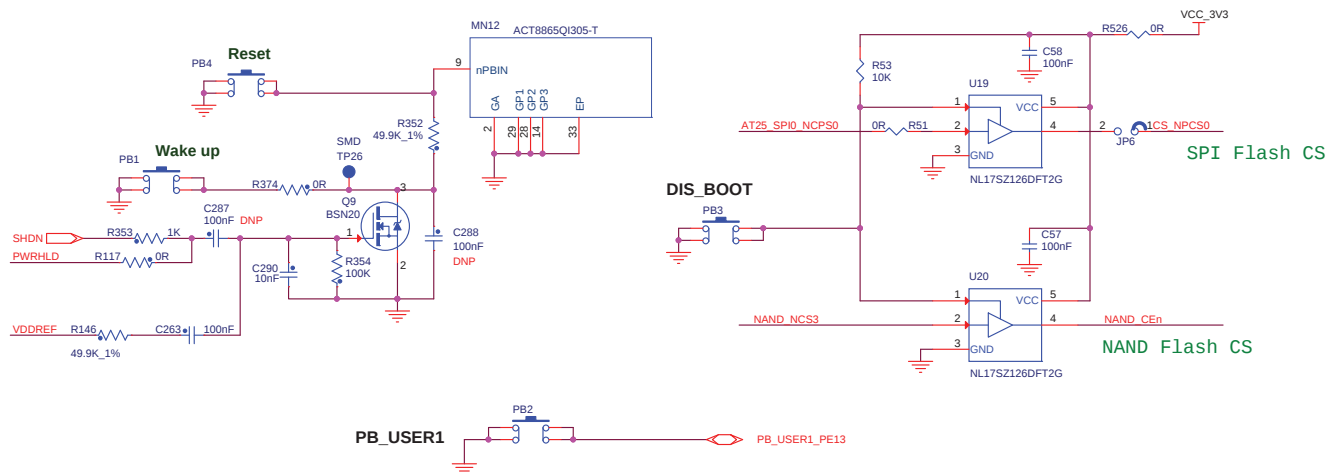


3.2.19.2 Pushbuttons and Switch

The SAMA5D4X-MB is equipped with three system pushbuttons and one user pushbutton. The push buttons are directly mounted to the board. When any switch is pressed, a low level (zero) is applied to the associated input pin. The pushbuttons are as follows:

- System pushbuttons:
 - Force Wake Up
 - Reset, perform system reset
 - Disable boot
- User pushbutton:
 - User pushbutton on GPIO

Figure 3-30. Pushbuttons



4. PIO Usage and Interface Connectors

4.1 Power Supply

Figure 4-1. Power Supply Connector J4

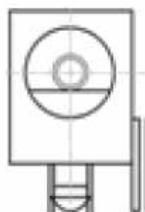


Table 4-1. Power Supply Connector J4 Signal Description

Pin	Mnemonic	Signal Description
1	Center	+5V
2		GND
3		Floating

4.2 JTAG/ICE Connector

Figure 4-2. JTAG J23

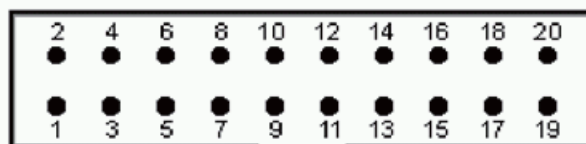


Table 4-2. JTAG/ICE Connector J23 Signal Descriptions

Pin	Mnemonic	Signal Description
1	VTref 3.3V power	This is the target reference voltage. It is used to check if the target has power, to create the logic-level reference for the input comparators, and to control the output logic levels to the target. It is normally fed from VDD on the target board and must not have a series resistor.
2	Vsupply 3.3V power	This pin is not connected in SAM-ICE™. It is reserved for compatibility with other equipment. Connect to VDD or leave open in target system.
3	nTRST Target Reset - Active-low output signal that resets the target.	JTAG Reset. Output from SAM-ICE to the Reset signal on the target JTAG port. Typically connected to nTRST on the target CPU. This pin is normally pulled High on the target to avoid unintentional resets when there is no connection.
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 of target CPU. It is recommended that this pin is pulled to a defined state on the target board. Typically connected to TDI on target CPU.

Table 4-2. JTAG/ICE Connector J23 Signal Descriptions (Continued)

Pin	Mnemonic	Signal Description
6	GND	Common ground
7	TMS Test Mode Select.	JTAG mode set input of target CPU. This pin should be pulled up on the target. Typically connected to TMS on target CPU. Output signal that sequences the target's JTAG state machine, sampled on the rising edge of the TCK signal.
8	GND	Common ground
9	TCK Test Clock - Output timing signal, for synchronizing test logic and control register access.	JTAG clock signal to target CPU. It is recommended that this pin is pulled to a defined state on the target board. Typically connected to TCK on target CPU.
10	GND	Common ground
11	RTCK - Input Return Test Clock signal from the target.	Some targets must synchronize the JTAG inputs to internal clocks. To assist in meeting this requirement, a returned and resynchronized TCK can be used to dynamically control the TCK rate. SAM-ICE supports adaptive clocking which waits for TCK changes to be echoed correctly before making further changes. Connect to RTCK if available, otherwise to GND.
12	GND	Common ground
13	TDO JTAG Test Data Output - Serial data input from the target.	JTAG data output from target CPU. Typically connected to TDO on 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 USB Type A Dual Port

Figure 4-3. USB Type A Dual Port J5

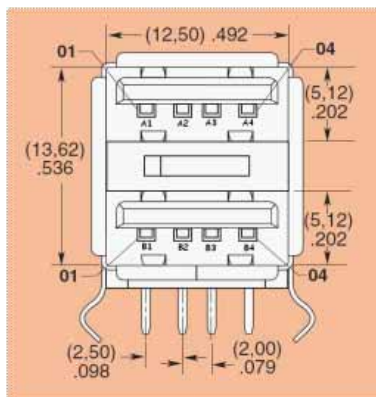


Table 4-3. USB Type A Dual Port J5 Signal Descriptions

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

4.4 USB Micro-AB

Figure 4-4. USB Host/Device MicroAB Connector J1



Table 4-4. USB Host/Device Micro AB Connector J1 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

4.5 JLINK-OB USB MicroAB

Figure 4-5. USB JLINK-OB MicroAB Connector J22

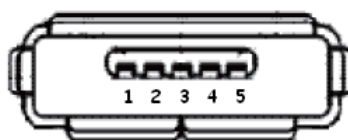


Table 4-5. USB JLINK-OB Micro-AB Connector J22 Signal Descriptions

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

4.6 HDMI Connector

Figure 4-6. HDMI Type A Female Connector J18

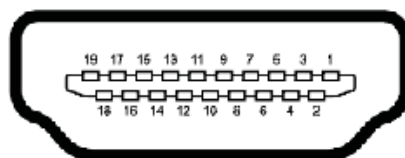


Table 4-6. HDMI Type A Female Connector J18 Signal Descriptions

LCD	Pin Number		LCD
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 -
NC	13	14	NC
SCL	15	16	SDA
GND	17	18	+5V
Hot Plug Detect	19		

4.7 RS232 Connector with RTS/CTS Handshake Support

Figure 4-7. USART1 Connector J24

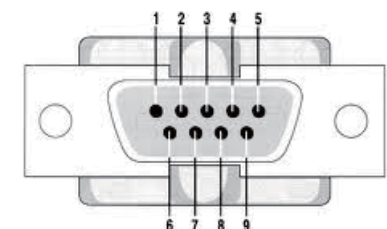


Table 4-7. USART Connector J24 Signal Descriptions

Pin	Mnemonic	Signal Description
1, 4, 6, 9	-	No connection
2	RXD (Received Data)	RS232 serial data output signal
3	TXD (Transmitted Data)	RS232 serial data input signal
5	GND	Common ground
7	RTS (Request To Send)	Active-positive RS232 input signal
8	CTS (Clear To Send)	Active-positive RS232 output signal
Mechanical pins	-	Shield

4.8 DAA RJ11 Socket (6P4C)

Figure 4-8. DAA RJ11 Socket J3

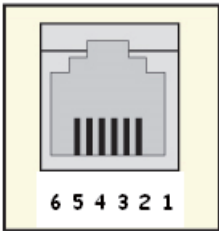


Table 4-8. DAA RJ11 Socket J3 Signal Descriptions

Pin Number	Mnemonic	Signal Description
1, 2, 5, 6		No connection
3	RAC	RING side of ordinary telephone line
4	TAC	TIP side of ordinary telephone line

4.9 SD/MMC Plus MCI0

Figure 4-9. SD Socket J20

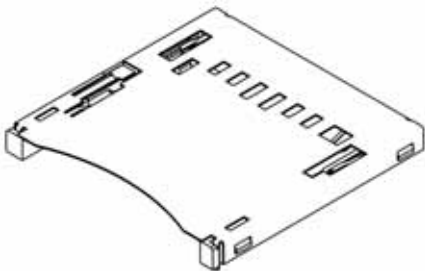


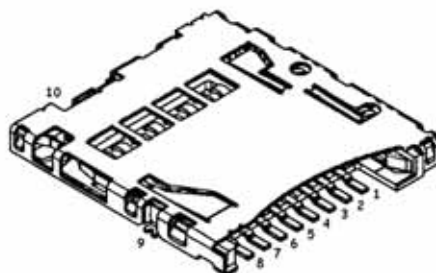
Table 4-9. SD Socket J20 Signal Descriptions

Pin Number	Mnemonic	Signal Description
1	DAT3	Data bit
2	CMD	Command line
3	VSS	Command line
4	VCC	Supply voltage 3.3V
5	CLK	Clock / command line
6	CD	Card detect
7	DAT0	Data bit
8	DAT1	Data bit
9	DAT2	Data bit
10	DAT4	Data bit

Table 4-9. SD Socket J20 Signal Descriptions (Continued)

Pin Number	Mnemonic	Signal Description
11	DAT5	Data bit
12	DAT6	Data bit
13	DAT7	Data bit
14	WP	Protect
15		Common ground
16		Common ground

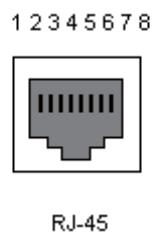
4.10 MicroSD MCI1

Figure 4-10. MicroSD Socket J14**Table 4-10. MicroSD Socket J14 Signal Descriptions**

Pin Number	Mnemonic	Signal Description
1	DAT2	Data bit 2
2	CD/DAT3	Card detect / data bit 3
3	CMD	Command line
4	VCC	Supply voltage 3.3V
5	CLK	Clock / command line
6	VSS	Common ground
7	DAT0	Data bit 0
8	DAT1	Data bit 1
9	SW1	Not used, grounded
10	CARD DETECT	Card detect
11		Common ground
12		Common ground
13		Common ground
14		Common ground

4.11 Ethernet ETH0/ETH1 RJ45 Socket J6/J7

Figure 4-11. Ethernet Standard RJ45 Socket J6/J7



4.12 XPro Socket

Figure 4-12. XPro Socket J11

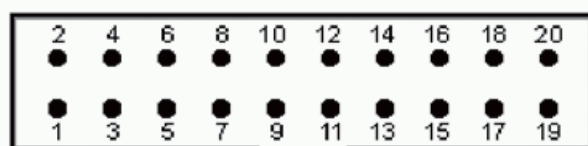


Table 4-11. XPro Socket J11 Signal Descriptions

EXT1 XPRO (20-pin Male Right-Angle Header)							
MCU Function	MCU Pin	Name	Pin Number		Name	MCU Pin	MCU Function
ID	PD28	ID	1	2	GND	-	-
AD0_XP	PC27	ADC(+)	3	4	ADC(-)	PC30	AD3/YM
CTS0	PD10	GPIO	5	6	GPIO	PD12	RXD0
PWMH3	PC2	PWM(+)	7	8	PWM(-)	PC3	PWML3
FIQ	PD29	IRQ/GPIO	9	10	SPI_SS_B/GPIO	PD14	CTS1
TWD2	PB29	TWI_SDA	11	12	TWI_SCL	PB30	TWCK2
RXD1	PD16	UART_RX	13	14	UART_TX	PD17	TXD1
SPI2_NPCS1	PB14	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	-	-

4.13 LCD Socket

Figure 4-13. LCD Socket J9

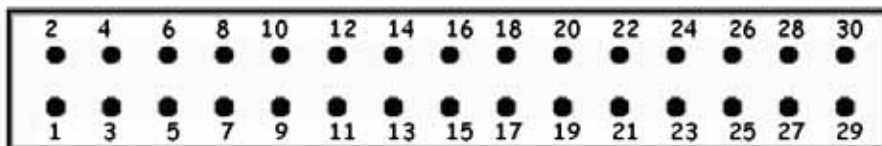


Table 4-12. LCD Socket J9 HE10 Female LCD 2x15 pts

LCD	Pin Number		LCD
VDD3V3	1	2	GND
VDD3V3	3	4	GND
LCD_PE24	5	6	LCD_PE25
TWCK0	7	8	TWD0
GND	9	10	LCDDAT15
GND	11	12	LCDDAT13
GND	13	14	LCDDAT14
GND	15	16	LCDDAT12
GND	17	18	LCDDAT0
LCDDAT1	19	20	LCDDAT2
LCDDAT3	21	22	LCDDAT4
LCDDAT5	23	24	LCDDAT6
LCDDAT7	25	26	LCDDAT8
LCDDAT9	27	28	LCDDAT10
LCDDAT11	29	30	GND

4.14 LCD/TSC Socket

Figure 4-14. LCD/TSC Socket J10

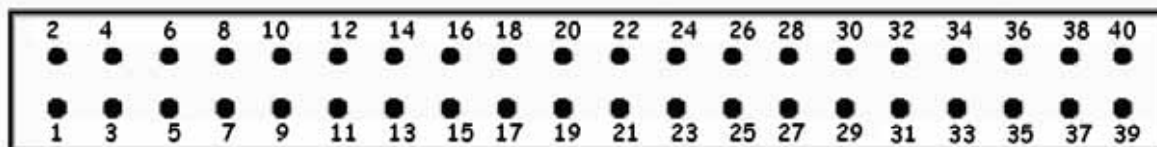


Table 4-13. LCD/TSC Socket J10 HE10 Female LCD/TSC/QT 2x20p

LCD		Pin Number			LCD
5V	5V_LCD	1	2	GND	GND
5V	5V_LCD	3	4	GND	GND
LCDDAT16	-	5	6	-	LCDDAT17

Table 4-13. LCD/TSC Socket J10 HE10 Female LCD/TSC/QT 2x20p (Continued)

LCD		Pin Number			LCD
LCDDAT18	-	7	8	-	LCDDAT19
LCDDAT20	-	9	10	-	LCDDAT21
LCDDAT22	-	11	12	-	LCDDAT23
GND	GND	13	14	GND	GND
LCDDISP	-	15	16	-	LCDPWM
LCDCSYNC	-	17	18	-	LCDHSYNC
LCDDEN	-	19	20	-	LCDPCK
GND	GND	21	22	GND	GND
AD0_XP	TSC	23	24	TSC	AD1_XM
AD2_YP	TSC	25	26	TSC	AD3_YM
AD4_LR	TSC	27	28	-	ONE_WIRE
GND1	GND	29	30	GND	GND
SPI1_MISO	-	31	32	-	SPI1_MOSI
SPI1_SPCK	-	33	34	-	SPI1_NPCS3
EN_PWRLCD	-	35	36	LCD_DETECT	LCD_DETECT#
-	PE26	37	38	PE27	-
GND	GND	39	40	GND	GND

4.15 ISI Socket

Figure 4-15. ISI Socket J15

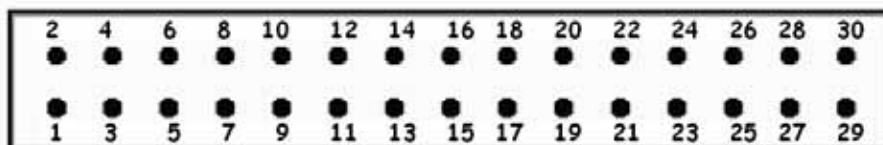


Table 4-14. ISI Socket J15 HE10 Female ISI 2x15p

ISI	Pin Number		ISI
VDDISI	1	2	GND
VDDISI	3	4	GND
ISI_RST	5	6	ISI_PWD
TWCK0	7	8	TWD0
GND	9	10	ISI_MCK
GND	11	12	ISI_VSYNC
GND	13	14	ISDI_HSYNC
GND	15	16	ISI_PCK
GND	17	18	ISI_D0

Table 4-14. ISI Socket J15 HE10 Female ISI 2x15p (Continued)

ISI	Pin Number		ISI
ISI_D1	19	20	ISI_D2
ISI_D3	21	22	ISI_D4
ISI_D5	23	24	ISI_D6
ISI_D7	25	26	ISI_D8
ISI_D9	27	28	ISI_D10
ISI_D11	29	30	GND

4.16 PIO Usage

4.16.1 PIO Pin Assignment and Signal Description

Table 4-15. PIO A Pin Assignment and Signal Description

Signal	Peripheral A	Peripheral B	Peripheral C	SAMA5-MB	
PA0	LCDDAT0		TMS	LCDDAT0	
PA1	LCDDAT1			LCDDAT1	
PA2	LCDDAT2	G1_TXCK		LCDDAT2	G1_TXCK
PA3	LCDDAT3	G1_RXCK		LCDDAT3	
PA4	LCDDAT4	G1_TXEN		LCDDAT4	G1_TXEN
PA5	LCDDAT5	G1_TXER		LCDDAT5	
PA6	LCDDAT6	G1_CRS		LCDDAT6	
PA7	LCDDAT7			LCDDAT7	
PA8	LCDDAT8		TCK	LCDDAT8	
PA9	LCDDAT9	G1_COL		LCDDAT9	
PA10	LCDDAT10	G1_RXDV		LCDDAT10	G1_RXDV
PA11	LCDDAT11	G1_RXER		LCDDAT11	G1_RXER
PA12	LCDDAT12	G1_RX0		LCDDAT12	G1_RX0
PA13	LCDDAT13	G1_RX1		LCDDAT13	G1_RX1
PA14	LCDDAT14	G1_TX0		LCDDAT14	G1_TX0
PA15	LCDDAT15	G1_TX1		LCDDAT15	G1_TX1
PA16	LCDDAT16		NTRST	LCDDAT16	
PA17	LCDDAT17			LCDDAT17	
PA18	LCDDAT18	G1_RX2		LCDDAT18	
PA19	LCDDAT19	G1_RX3		LCDDAT19	
PA20	LCDDAT20	G1_TX2		LCDDAT20	
PA21	LCDDAT21	G1_TX3		LCDDAT21	
PA22	LCDDAT22	G1_MDC		LCDDAT22	G1_MDC
PA23	LCDDAT23	G1_MDIO		LCDDAT23	G1_MDIO
PA24	LCDPWM	PCK0		LCDPWM	
PA25	LCDDISP	TD0		LCDDISP	
PA26	LCDVSYNC	PWMH0	SPI1_NPCS1	LCDVSYNC	
PA27	LCDHSYNC	PWML0	SPI1_NPCS2	LCDHSYNC	
PA28	LCDPCK	PWMH1	SPI1_NPCS3	LCDPCK	
PA29	LCDDEN	PWML1		LCDDEN	
PA30	TWD0			TWD0	
PA31	TWCK0			TWCK0	

Table 4-16. PIO B Pin Assignment and Signal Description

Signal	Peripheral A	Peripheral B	Peripheral C	SAMA5-MB	
PB0	G0_TXCK			G0_TXCK	
PB1	G0_RXCK	SCK2	ISI_PCK		ISI_PCK
PB2	G0_TXEN			G0_TXEN	
PB3	G0_TXER	CTS2	ISI_VSYNC		ISI_VSYNC
PB4	G0_CRS	RXD2	ISI_HSYNC		ISI_HSYNC
PB5	G0_COL	TXD2	PCK2		ISI_PWD
PB6	G0_RXDV			G0_RXDV	
PB7	G0_RXER			G0_RXER	
PB8	G0_RX0			G0_RX0	
PB9	G0_RX1			G0_RX1	
PB10	G0_RX2	PCK2	PWML1		PCK2
PB11	G0_RX3	RTS2	PWMH1		ISI_RST
PB12	G0_TX0			G0_TX0	
PB13	G0_TX1			G0_TX1	
PB14	G0_TX2	SPI2_NPCS1	PWMH0		PB14
PB15	G0_TX3	SPI2_NPCS2	PWML0		HDMI_RST
PB16	G0_MDC			G0_MDC	
PB17	G0_MDIO			G0_MDIO	
PB18	SPI1_MISO	D8		SPI1_MISO	
PB19	SPI1_MOSI	D9		SPI1_MOSI	
PB20	SPI1_SPCK	D10		SPI1_SPCK	
PB21	SPI1_NPCS0	D11			SPI1_NPCS0
PB22	SPI1_NPCS1	D12		SPI1_NPCS1	
PB23	SPI1_NPCS2	D13			SPI1_NPCS2
PB24	DRXD	D14	TDI	TDI	
PB25	DTXD	D15	TDO	TDO	
PB26	PCK0	RK0	PWMH0		RK0
PB27	SPI1_NPCS3	TK0	PWML0		TK0
PB28	SPI2_NPCS3	TD0	PWMH1		TD0
PB29	TWD2	RD0	PWML1		RD0
PB30	TWCK2	RF0			RF0
PB31		TF0			TF0

Table 4-17. PIO C Pin Assignment and Signal Description

Signal	Peripheral A	Peripheral B	Peripheral C	SAMA5-MB	
PC0	SPI0_MISO	PWMH2	ISI_D8	SPI0_MISO	ISI_D8
PC1	SPI0_MOSI	PWML2	ISI_D9	SPI0_MOSI	ISI_D9
PC2	SPI0_SPCK	PWMH3	ISI_D10	SPI0_SPCK	ISI_D10
PC3	SPI0_NPCS0	PWML3	ISI_D11	SPI0_NPCS0	ISI_D11
PC4	SPI0_NPCS1	MCI0_CK	PCK1		MCI0_CK
PC5	D0	MCI0_CDA		D0	MCI0_CDA
PC6	D1	MCI0_DA0		D1	MCI0_DA0
PC7	D2	MCI0_DA1		D2	MCI0_DA1
PC8	D3	MCI0_DA2		D3	MCI0_DA2
PC9	D4	MCI0_DA3		D4	MCI0_DA3
PC10	D5	MCI0_DA4		D5	MCI0_DA4
PC11	D6	MCI0_DA5		D6	MCI0_DA5
PC12	D7	MCI0_DA6		D7	MCI0_DA6
PC13	NRD/NANDOE	MCI0_DA7		NRD/NANDOE	MCI0_DA7
PC14	NWE/NANDWE			NWE/NANDWE	
PC15	NCS3			NCS3	
PC16	NANDRDY			NANDRDY	
PC17	A21/NANDALE			A21/NANDALE	
PC18	A22/NANDCLE			A22/NANDCLE	
PC19	ISI_D0	TK1			ISI_D0
PC20	ISI_D1	TF1			ISI_D1
PC21	ISI_D2	TD1			ISI_D2
PC22	ISI_D3	RF1			ISI_D3
PC23	ISI_D4	RD1			ISI_D4
PC24	ISI_D5	RK1	PCK1		ISI_D5
PC25	ISI_D6	TWD3	URXD1		ISI_D6
PC26	ISI_D7	TWCK3	UTXD1		ISI_D7
PC27	AD0	SPI0_NPCS1	PWML0	AD0	
PC28	AD1	SPI0_NPCS2	PWML1	AD1	
PC29	AD2	SPI0_NPCS3	PWMFIO	AD2	
PC30	AD3		PWMH0	AD3	
PC31	AD4		PWMH1	AD4	

Table 4-18. PIO D Pin Assignment and Signal Description

Signal	Peripheral A	Peripheral B	Peripheral C	SAMA5-MB	
PD1					
PD2					
PD3					
PD4					
PD5					
PD6					
PD7					
PD8	PCK0				PCK0
PD9	FIQ			OVCUR_USB	
PD10	CTS0	CDETA			PD10
PD11	RTS0	SPI2_MISO			PD11
PD12	RXD0	DCENA			PD12
PD13	TXD0	SPI2_MOSI			PD13
PD14	CTS1	CDETB			PD14
PD15	RTS1	SPI2_SPCK			PD15
PD16	RXD1	DCENB			PD16
PD17	TXD1	SPI2_NPCS0			PD17
PD18		SENSE0			
PD19		SENSE1			
PD20		SENSE2			
PD21		SENSE3			
PD22		SENSE4			
PD23		SENSE5			
PD24		SENSE6			
PD25		SENSE7			
PD26		SENSE8			
PD27		SENSE9			
PD28	SCK0			PD28	
PD29	SCK1	DIS		PD29	
PD30					
PD31	SPI0_NPCS2	PCK1			

Table 4-19. PIO E Pin Assignment and Signal Description

Signal	Peripheral A	Peripheral B	Peripheral C	SAMA5-MB	
PE0	A0/NBS0	MCI0_CDB	CTS4	INT_PMIC	
PE1	A1	MCI0_DB0		INT_ETH0	
PE2	A2	MCI0_DB1		INT_ETH1	
PE3	A3	MCI0_DB2		INT_HDMI	
PE4	A4	MCI0_DB3		INT_AUDIO	
PE5	A5	CTS3			CD_MCI0
PE6	A6	TIOA3			CD_MCI1
PE7	A7	TIOB3	PWMFI1		
PE8	A8	TCLK3	PWML3	USER_LED1	
PE9	A9	TIOA2		POWER_LED	
PE10	A10	TIOB2		EN5V_USBA	
PE11	A11	TCLK2		EN5V_USBB	
PE12	A12	TIOA1	PWMH2	EN5V_USBC	
PE13	A13	TIOB1	PWML2	PB_USER1	
PE14	A14	TCLK1	PWMH3		
PE15	A15	SCK3	TIOA0		PWR_MCI1
PE16	A16	RXD3	TIOB0	RXD3	
PE17	A17	TXD3	TCLK0	TXD3	
PE18	A18	TIOA5	MCI1_CK		MCI1_CK
PE19	A19	TIOB5	MCI1_CDA		MCI1_CDA
PE20	A20	TCLK5	MCI1_DA0		MCI1_DA0
PE21	A23	TIOA4	MCI1_DA1		MCI1_DA1
PE22	A24	TIOB4	MCI1_DA2		MCI1_DA2
PE23	A25	TCLK4	MCI1_DA3		MCI1_DA3
PE24	NCS0	RTS3			PE24
PE25	NCS1	SCK4	IRQ		PE25
PE26	NCS2	RXD4	A18		RXD4
PE27	NWR1/NBS1	TXD4			TXD4
PE28	NWAIT	RTS4	A19		1-WIRE
PE29	DIBP	URXD0	TWD1		DIBP
PE30	DIBN	UTXD0	TWCK1		DIBN
PE31	ADTRG				PE31

4.16.2 IO Expansion Port

Figure 4-16. IO Expansion Socket J19

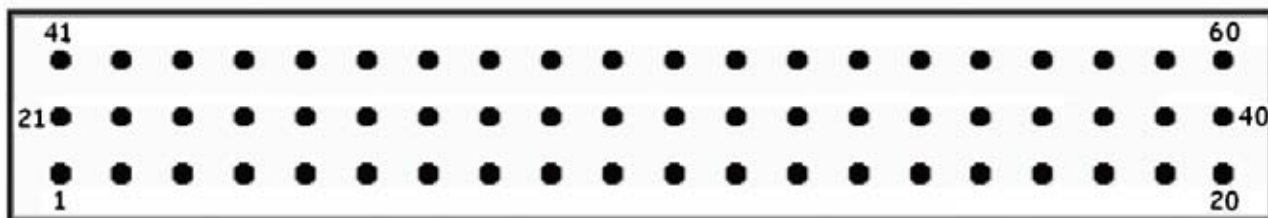


Table 4-20. IO Expansion Socket J19 Signal Descriptions

Signal	Pin Number	Signal	Pin Number	Signal	Pin Number
PB0	1	VCC3V3	21	PE9	41
PB2	2	VCC3V3	22	PE10	42
PB6	3	PE31	23	PE11	43
PB7	4	PA24	24	PE12	44
PB8	5	PA25	25	PE13	45
PB9	6	PC4	26	PE14	46
PB10	7	PD8	27	PE15	47
PB12	8	PD30	28	PE16	48
PB13	9	PD31	29	PE17	49
PB15	10	-	30	PE18	50
GND	11	GND	31	GND	51
PB16	12	PE0	32	PE19	52
PB17	13	PE1	33	PE20	53
PB21	14	PE2	34	PE21	54
PB22	15	PE3	35	PE22	55
PB24	16	PE4	36	PE23	56
PB25	17	PE5	37	PE24	57
PB27	18	PE6	38	PE25	58
PB28	19	PE7	39	PE26	59
PB31	20	PE8	40	PE27	60

5. Schematics

This section contains the following schematics:

- “Block diagram”
- “PIO Assignment”
- “Power supply”
- “MPU - Power”
- “MPU - PIOA, PIOE”
- “MPU - PIOB, PIOD, SYS”
- “DDR2 - I”
- “DDR2 - II”
- “MPU - PIOC, Flash”
- “MCI”
- “USB”
- “ETH0”
- “ETH1”
- “DAA”
- “HDMI”
- “AUDIO”
- “DBGU - SAM3U”
- “LCD, ISI I/F”
- “EXT - CON, Buttons, LED”

Figure 5-1. Block diagram

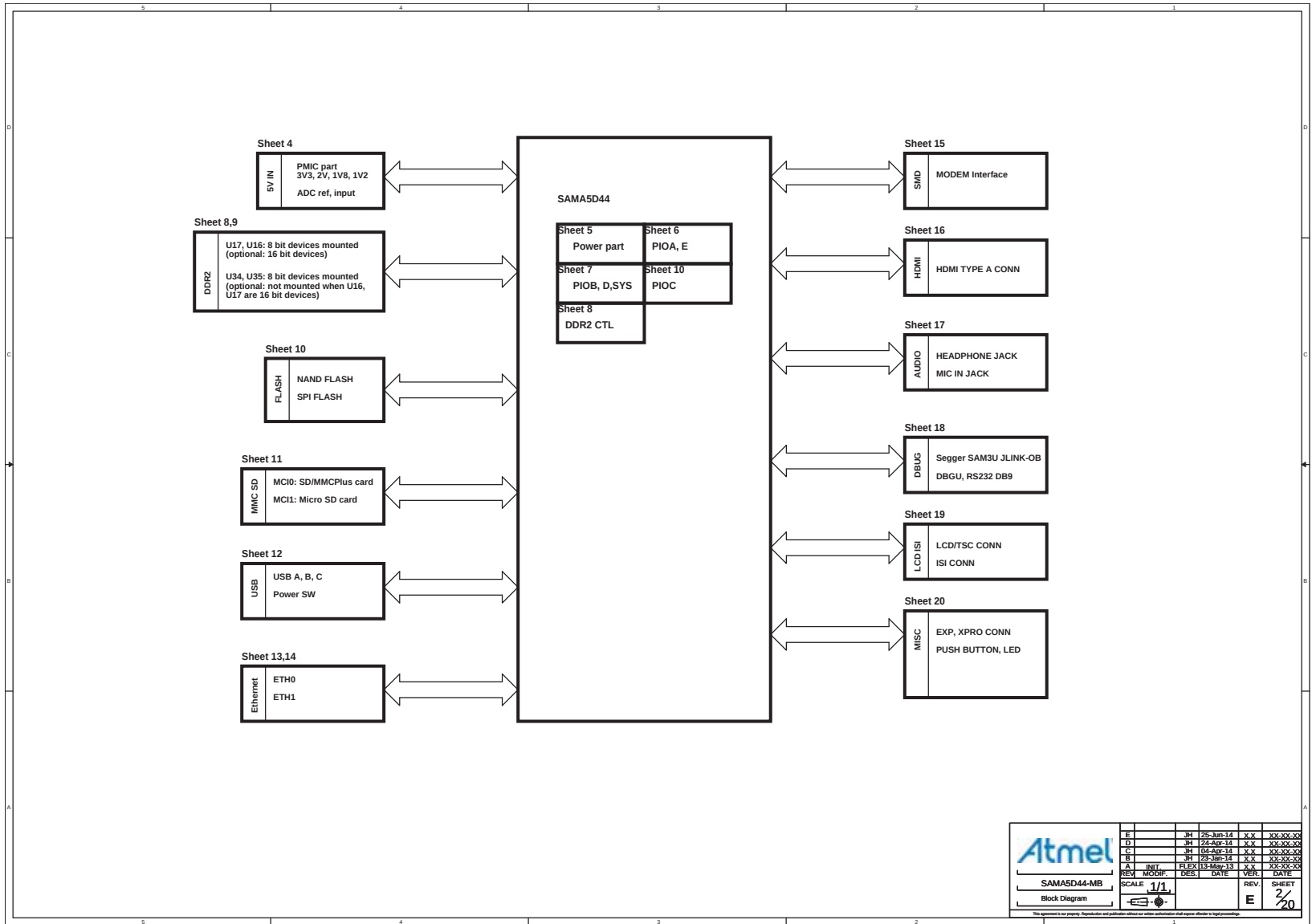


Figure 5-2. PIO Assignment

PIO Muxing & Jumper setting

PIOA	USAGE	PIOA	USAGE	PIOB	USAGE	PIOB	USAGE	PIOC	USAGE	PIOC	USAGE
PA0	LCDDAT0/TMS	PA16	LCDDAT16/NTRST	PB0	G0_TXCK/EXP	PB16	G0_MDC/EXP	PC0	AT25_SPI0_SO/ISL_D8	PC16	NANDRDY
PA1	LCDDAT1	PA17	LCDDAT17	PB1	ISL_PCK	PB17	G0_MDIO/EXP	PC1	AT25_SPI0_SII/ISL_D9	PC17	NAND_ALE
PA2	LCDDAT2/G1_TXCK	PA18	LCDDAT18	PB2	G0_TXEN/EXP	PB18	LCD_SPI1_SO	PC2	SPCK/ISL_D10/PWMH3	PC18	NAND_CLE
PA3	LCDDAT3	PA19	LCDDAT19	PB3	ISL_VSYNC	PB19	LCD_SPI1_SI	PC3	NCPS0/ISL_D11/PWML3	PC19	ISL_D0
PA4	LCDDAT4/G1_TXEN	PA20	LCDDAT20	PB4	ISL_HSYNC	PB20	LCD_SPI1_CLK	PC4	MCIO_CK/ISL_MCK/EXP	PC20	ISL_D1
PA5	LCDDAT5	PA21	LCDDAT21	PB5	ISL_PWD	PB21	EXP	PC5	MCIO_CDA/NAND_IO0	PC21	ISL_D2
PA6	LCDDAT6	PA22	LCDDAT22/G1_MDC	PB6	G0_RXDV/EXP	PB22	EXP	PC6	MCIO_DA0/NAND_IO1	PC22	ISL_D3
PA7	LCDDAT7	PA23	LCDDAT23/G1_MDIO	PB7	G0_RXER/EXP	PB23	LCD_SPI1_NPCS2	PC7	MCIO_DA1/NAND_IO2	PC23	ISL_D4
PA8	LCDDAT8/TCK	PA24	LCDPWM/EXP	PB8	G0_RX0/EXP	PB24	TDI/EXP	PC8	MCIO_DA2/NAND_IO3	PC24	ISL_D5
PA9	LCDDAT9	PA25	LCDDISP/EXP	PB9	G0_RX1/EXP	PB25	TD0/EXP	PC9	MCIO_DA3/NAND_IO4	PC25	ISL_D6
PA10	LCDDAT10/G1_RXDV	PA26	LCDDVSYNC	PB10	AUDIO_PCK2/EXP	PB26	AUDIO_RK0	PC10	MCIO_DA4/NAND_IO5	PC26	ISL_D7
PA11	LCDDAT11/G1_RXER	PA27	LCDDHSYNC	PB11	ISL_RST	PB27	AUDIO/HDMI_TK0/EXP	PC11	MCIO_DA5/NAND_IO6	PC27	AD0_XP
PA12	LCDDAT12/G1_RX0	PA28	LCDDPCK	PB12	G0_TX0/EXP	PB28	AUDIO/HDMI_TD0/EXP	PC12	MCIO_DA6/NAND_IO7	PC28	AD1_XM
PA13	LCDDAT13/G1_RX1	PA29	LCDDEN	PB13	G0_TX1/EXP	PB29	AUDIO_RD0/XPRO_TWD2	PC13	MCIO_DA7/NAND_RE	PC29	AD2_YP
PA14	LCDDAT14/G1_TX0	PA30	TWD0	PB14	XPRO_SPI2_NPCS1	PB30	AUDIO_RF/XPRO_TWCK2	PC14	NWE/NANDWE	PC30	AD3_YM
PA15	LCDDAT15/G1_TX1	PA31	TWCK0	PB15	HDMI_RST	PB31	AUDIO/HDMI_TF0/EXP	PC15	NAND_NCS3	PC31	AD4_LR/ADC_INPUT

EXP I/F 3X20					
1	PB0	21	VCC_3V3	41	PE9
2	PB2	22	VCC_3V3	42	PE10
3	PB6	23	ADTRG_P331	43	PE11
4	PB7	24	PA24	44	PE12
5	PB8	25	PA25	45	PE13
6	PB9	26	PC4	46	PE14
7	PB10	27	PD8	47	PE15
8	PB12	28	PD30	48	PE16
9	PB13	29	PD31	49	PE17
10	PB15	30	NC	50	PE18
11	GND	31	GND	51	GND
12	PB16	32	PE0	52	PE19
13	PB17	33	PE1	53	PE20
14	PB21	34	PE2	54	PE21
15	PB22	35	PE3	55	PE22
16	PB24	36	PE4	56	PE23
17	PB25	37	PE5	57	PE24
18	PB27	38	PE6	58	PE25
19	PB28	39	PE7	59	PE26
20	PB31	40	PE8	60	PE27

PIOD	USAGE	PIOD	USAGE	PIOE	USAGE	PIOE	USAGE
		PD16	XPRO_RXD1_PD16	PE0	PMIC_IRQ	PE16	DBGU_RXD3
		PD17	XPRO_NPCS0_TXD1	PE1	G0_IRQ	PE17	DBGU_TXD3
		PD18	NC	PE2	G1_IRQ	PE18	MC11_CK/EXP
		PD19	NC	PE3	HDMI_IRQ	PE19	MC11_CDA/EXP
		PD20	NC	PE4	AUDIO_IRQ	PE20	MC11_DA0/EXP
		PD21	NC	PE5	MCIO_CD	PE21	MC11_DA1/EXP
		PD22	NC	PE6	MC11_CD	PE22	MC11_DA2/EXP
		PD23	NC	PE7	EXP	PE23	MC11_DA3/EXP
PD8	EXP_PCK0	PD24	NC	PE8	LED_USER	PE24	LCD_PE24
PD9	USB_OVCUR_PD9	PD25	NC	PE9	LED_POWER	PE25	LCD_PE25
PD10	XPRO_CTS0	PD26	NC	PE10	EN5V_USBA	PE26	RXD4
PD11	XPRO_MISO_RTS0	PD27	NC	PE11	EN5V_USBB	PE27	TXD4
PD12	XPRO_RXD0	PD28	SCK0	PE12	EN5V_USBC	PE28	1-WIRE
PD13	XPRO_MOSI_TXD0	PD29	SCK1	PE13	PB_USER1	PE29	DIBP
PD14	XPRO_CTS1	PD30	EXP	PE14	EXP	PE30	DIBN
PD15	XPRO_SPCK_RTS1	PD31	EXP	PE15	MC11_PWR	PE31	USBA_VBUS/ADTRG

XPRO I/F 2X10			
SCK0	1	2	GND
AD0	3	4	AD3
CTS0	5	6	RXD0
PWMH3	7	8	PWML3
SCK1	9	10	CTS1
TWD2	11	12	TWCK2
RXD1	13	14	TXD1
SPI2_NPCS1	15	16	SPI2_MOSI
SPI2_MISO	17	18	SPI2_SPCK
GND	19	20	VCC_3V3

JUMPER DESCRIPTION		
PART	DEFAULT	FUNCTION
JP2	OPEN	LCD Power enable; ETH1 disable
JP3	CLOSE	5V output enable for USB-A
JP5	CLOSE	SDMMC Card write protection selection
JP6	OPEN	SPI Flash Selection
JP7	OPEN	PIOB03 connect to GND selection
JP8	OPEN	PIOB00 connect to PIOB01 selection
JP10	OPEN	JLINK-OB CDC enable
JP11	OPEN	JLINK-OB JTAG enable
JP12	1-2(Def)	SAM3U power by on board VCC_3V3
	2-3	SAM3U power by USB VBUS LDO
JP13	CLOSE	VDDBU_2V
JP14	CLOSE	VCC_5V
JP15	CLOSE	VDDIODDR_MPU
JP16	CLOSE	VDDCORE
JP17	CLOSE	1V2_HDMI
JP18	CLOSE	VCC_3V3
JP19,JP20	2-1	DBGU to RS232
	2-3(Def)	DBGU to JLINK-OB CDC
JP21	OPEN	Enable DBGU
JP22	2-1(Def)	ADC_VREF connect to VDDANA
	2-3	ADC_VREF connect to 3V
JP24	OPEN	For CTS.RTS usage

LCD/TSC 2x20			
VCC_5V	1	2	GND
VCC_5V	3	4	GND
LCDDAT22	5	6	LCDDAT23
LCDDAT0	7	8	LCDDAT1
LCDDAT8	9	10	LCDDAT9
LCDDAT16	11	12	LCDDAT17
GND	13	14	GND
LCDDISP	15	16	LCDDPWM
LCDDVSYNC	17	18	LCDDHSYNC
LCDDEN	19	20	LCDDPCK
GND	21	22	GND
AD0_XP	23	24	AD1_XM
AD2_YP	25	26	AD3_YM
AD4_LR	27	28	1-WIRE
GND	29	30	GND
SPI1_MISO	31	32	SPI1_MOSI
SPI1_SPCK	33	34	SPI1_NPCS2
EN_PWRLCD	35	36	LCD_DETECT
RXD4	37	38	TXD4
GND	39	40	GND

LCD 2x15			
VCC_3V3	1	2	GND
VCC_3V3	3	4	GND
GPIO_PE24	5	6	GPIO_PE25
TWCK0	7	8	TWD0
GND	9	10	LCDDAT21
GND	11	12	LCDDAT19
GND	13	14	LCDDAT20
GND	15	16	LCDDAT18
GND	17	18	LCDDAT2
LCDDAT3	19	20	LCDDAT4
LCDDAT5	21	22	LCDDAT6
LCDDAT7	23	24	LCDDAT10
LCDDAT11	25	26	LCDDAT12
LCDDAT13	27	28	LCDDAT14
LCDDAT15	29	30	GND

ISI 2x15			
VCC_3V3	1	2	GND
VCC_3V3	3	4	GND
ISL_RST	5	6	ISL_PWD
TWCK0	7	8	TWD0
GND	9	10	ISL_MCK
GND	11	12	ISL_VSYNC
GND	13	14	ISL_HSYNC
GND	15	16	ISL_PCK
GND	17	18	ISL_D0
ISL_D1	19	20	ISL_D2
ISL_D3	21	22	ISL_D4
ISL_D5	23	24	ISL_D6
ISL_D7	25	26	ISL_D8
ISL_D9	27	28	ISL_D10
ISL_D11	29	30	GND

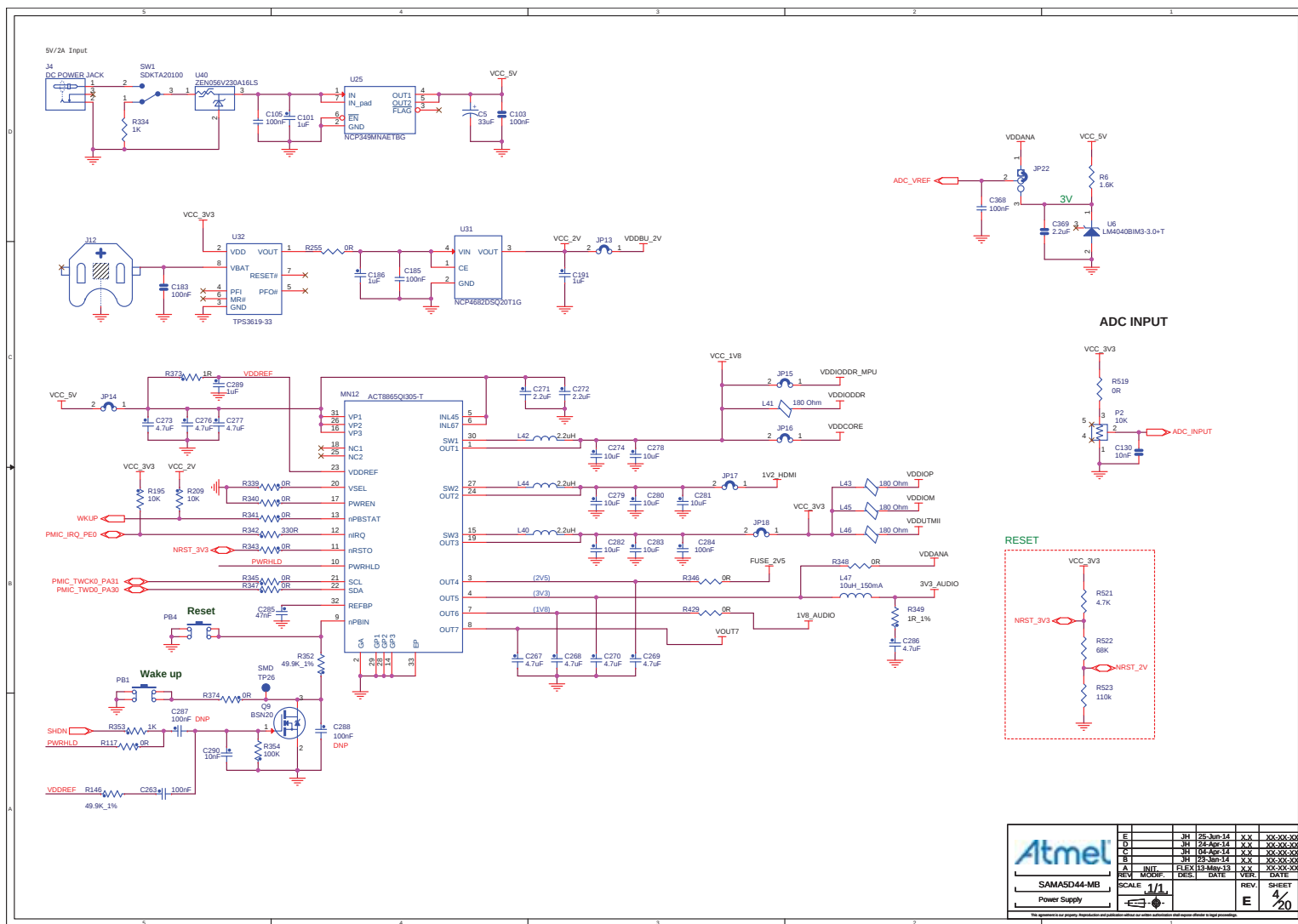


SAM5D4-MB

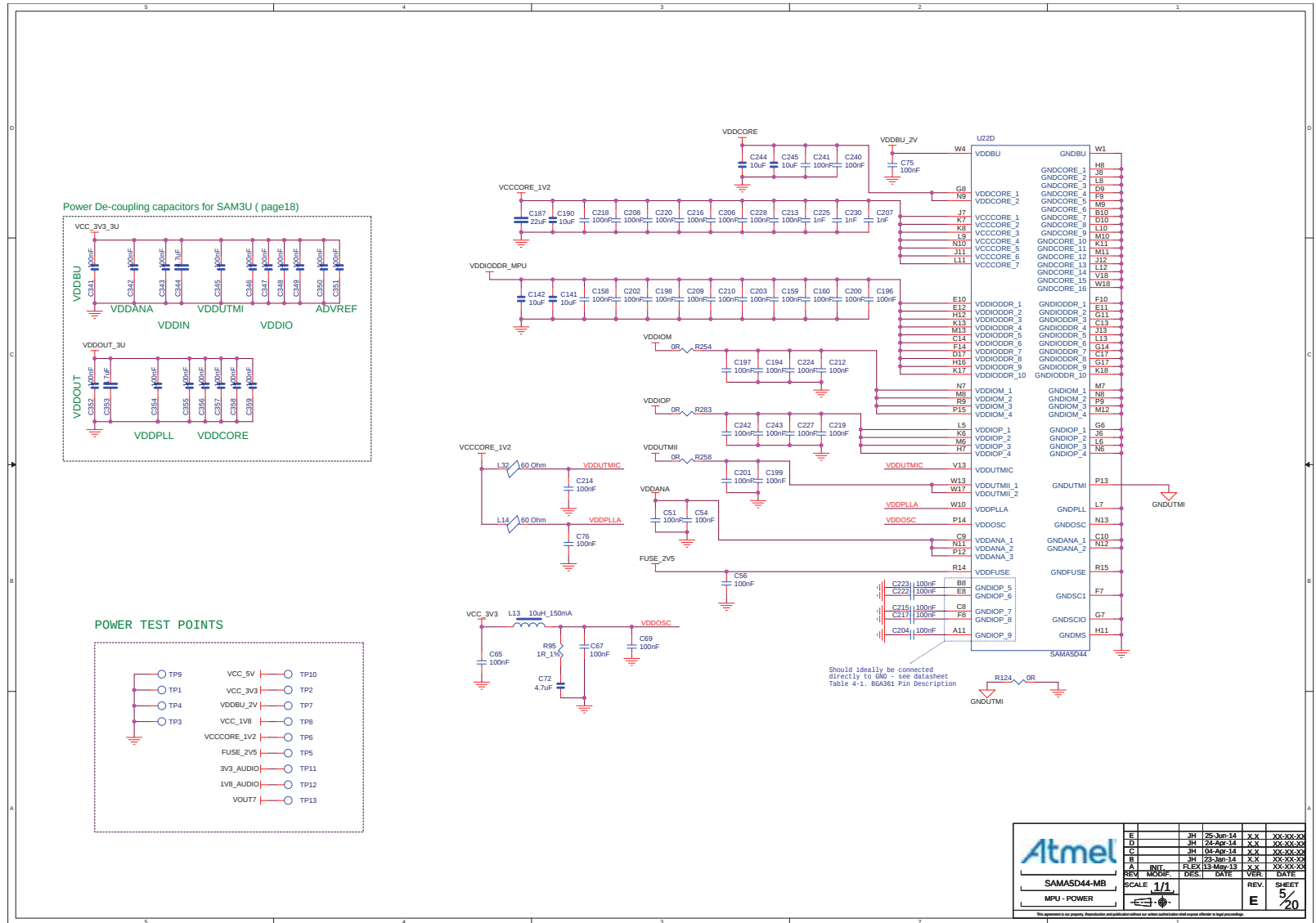
PIO Muxing & Jumper setting

E				31	25-32-33	2 x x	00000000
D				30	25-32-33	2 x x	00000000
C				29	25-32-33	2 x x	00000000
B				28	25-32-33	2 x x	00000000
A				27	25-32-33	2 x x	00000000
REV	INT	INT	INT	INT	INT	INT	INT
SCALE	1/1						
REV	E						
SHEET	1						

50



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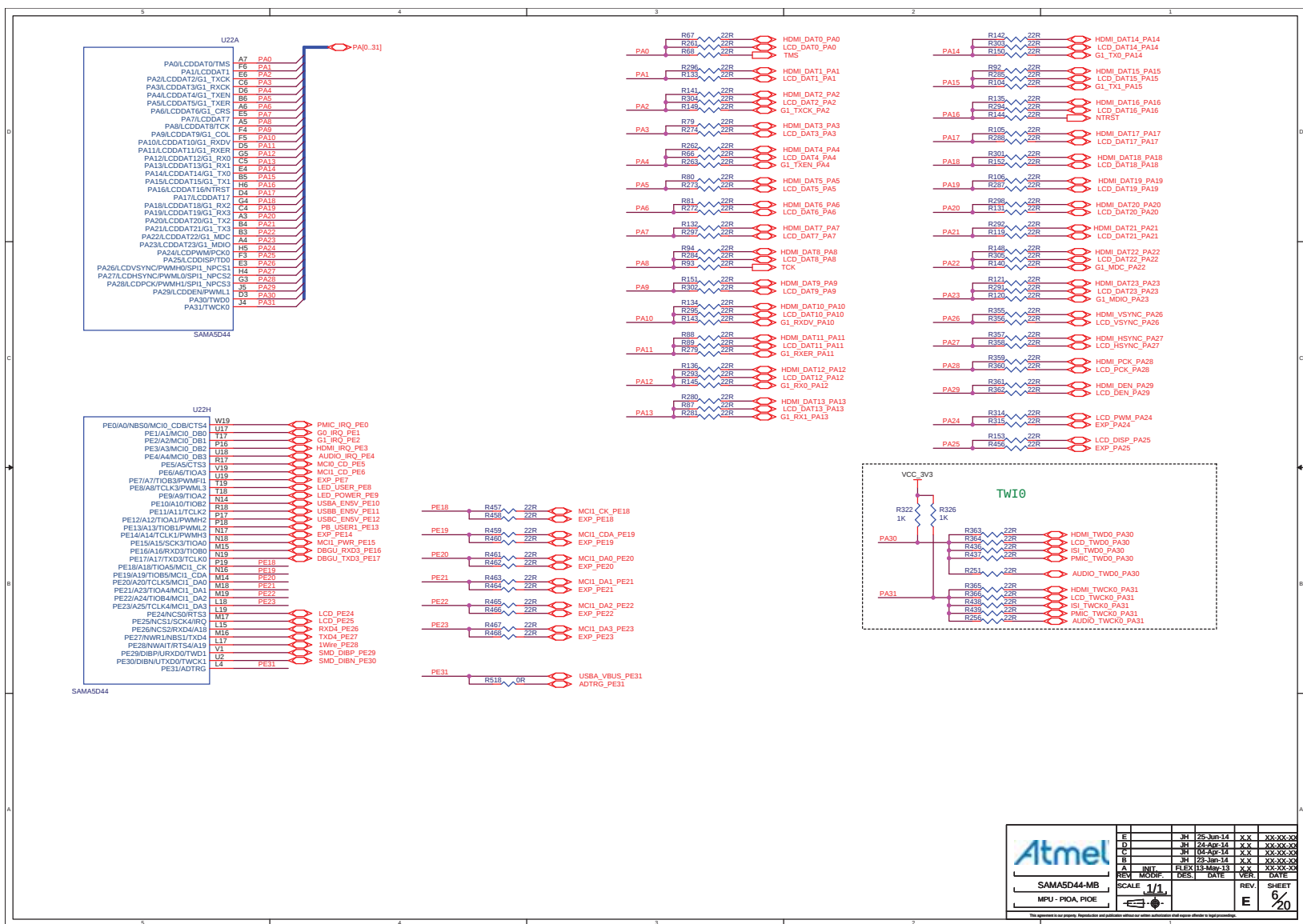
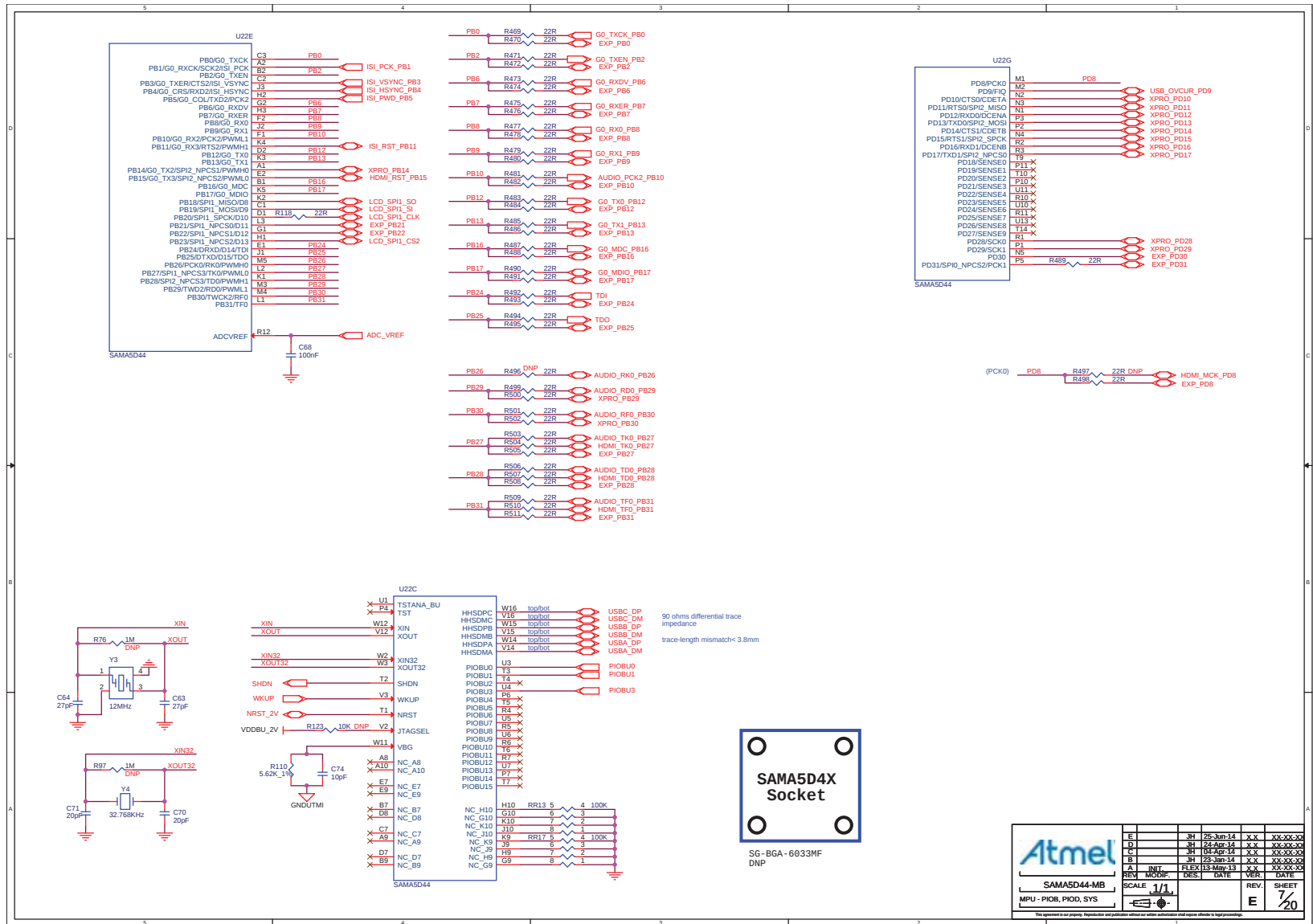
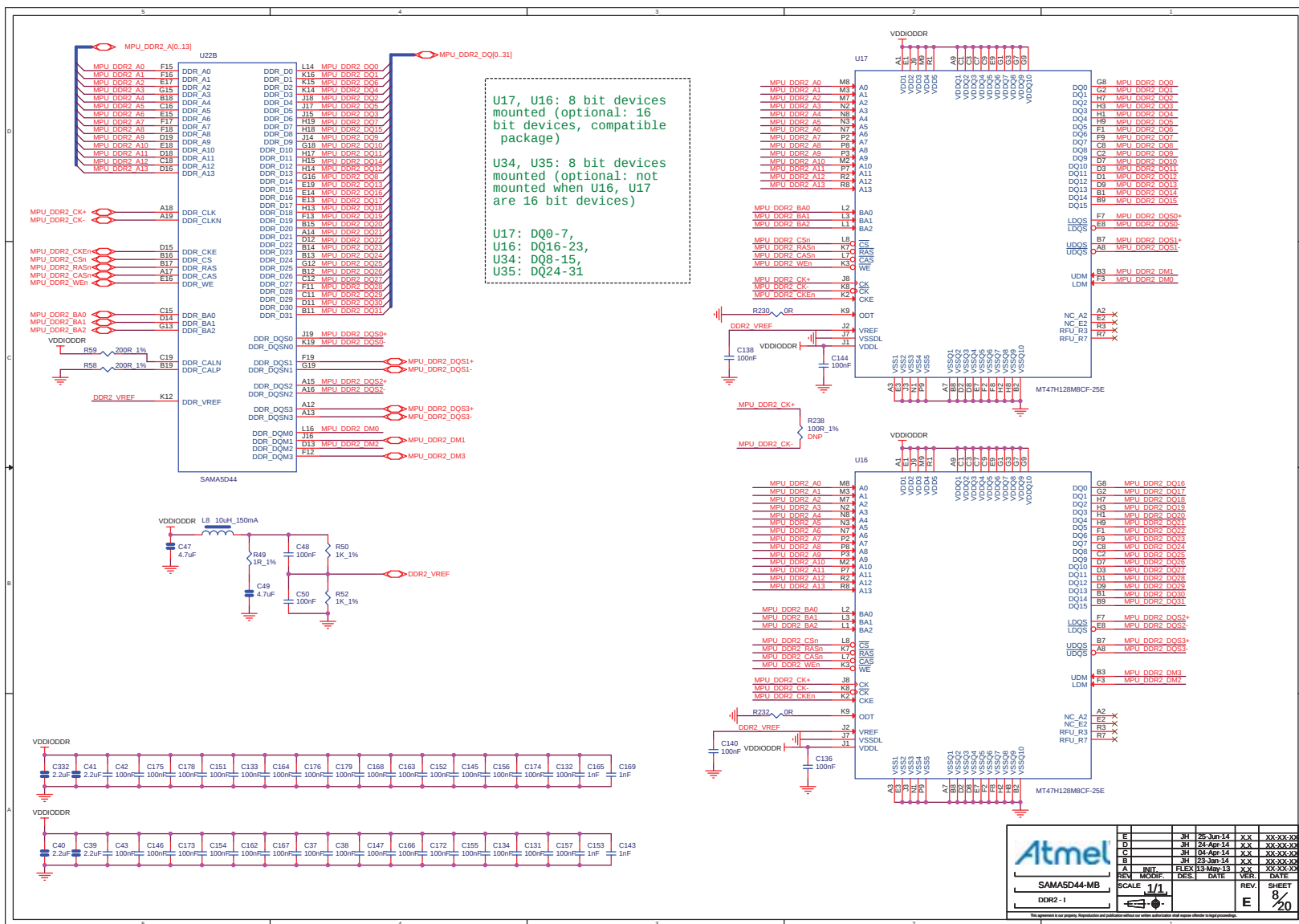


Figure 5-6. MPU - PIOB, PIOD, SYS



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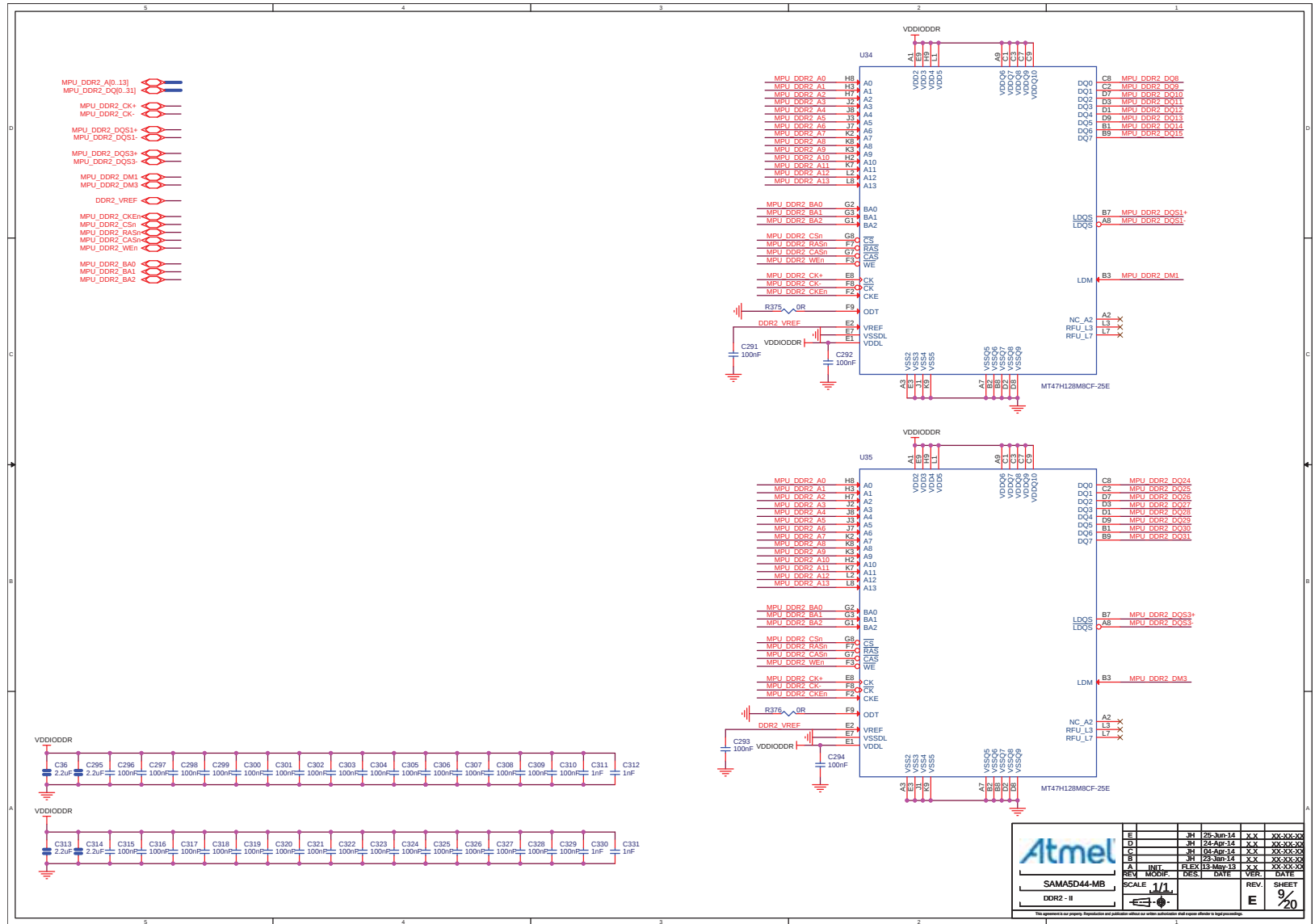


Figure 5-9. MPU - PIOC, Flash

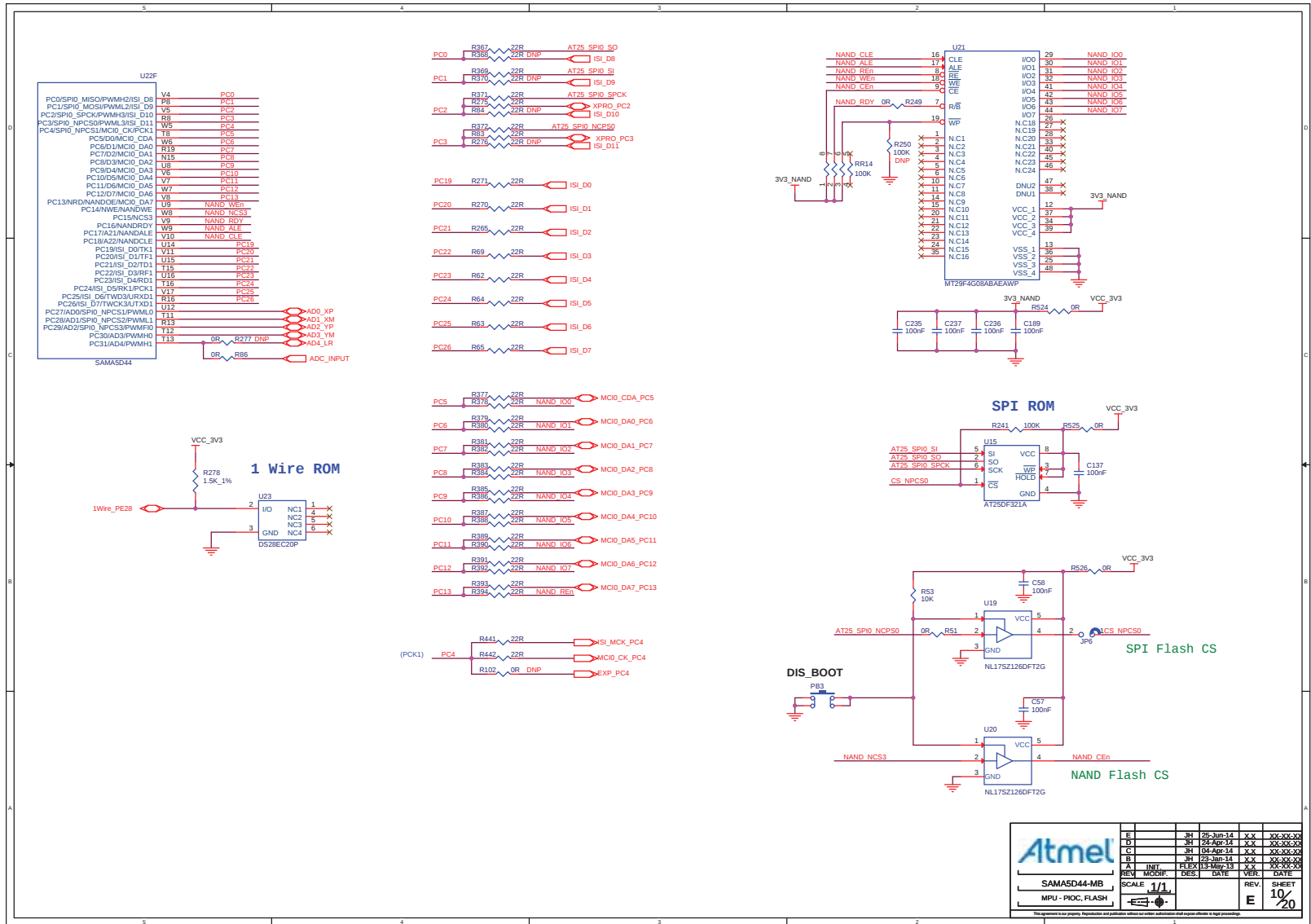
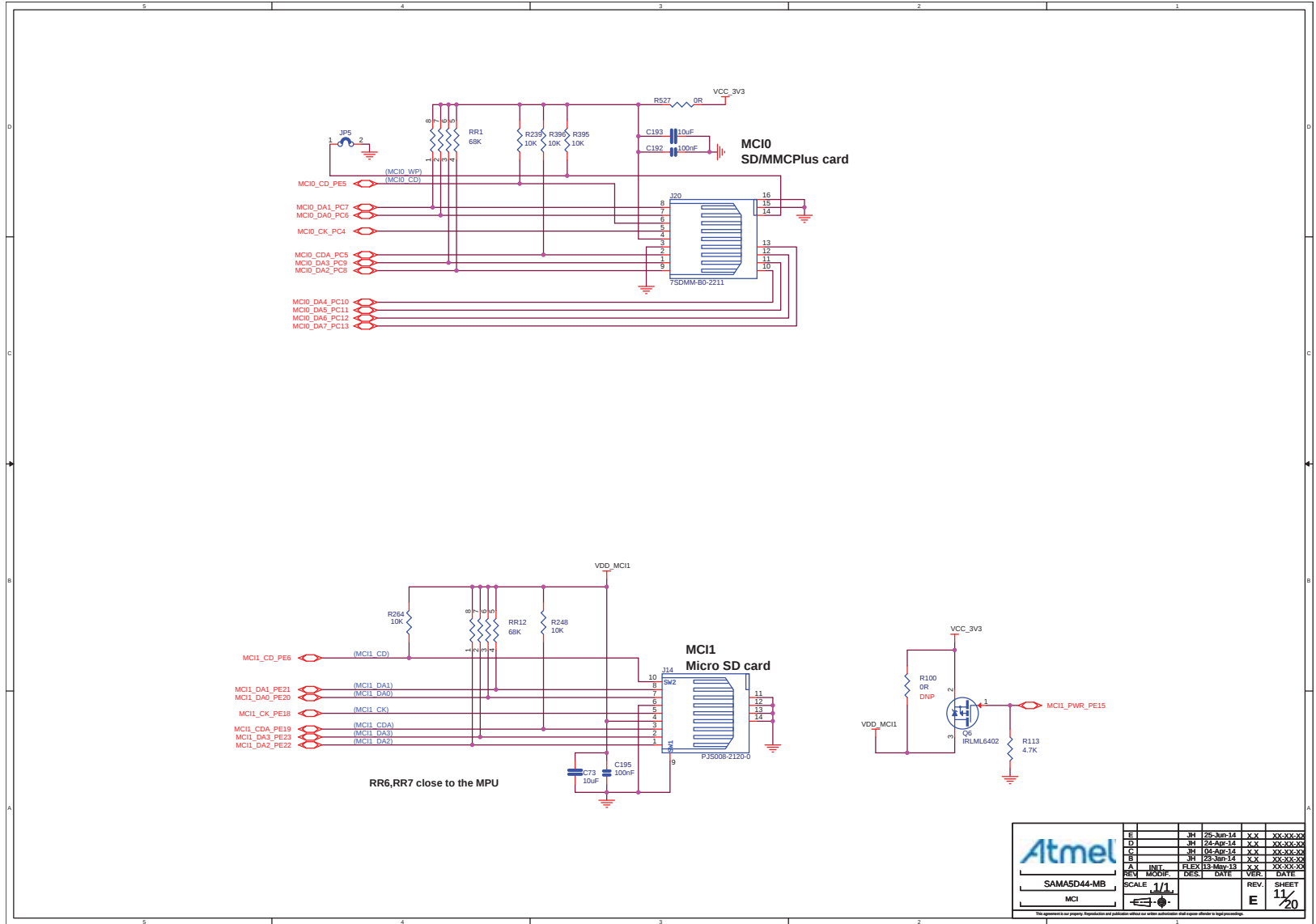


Figure 5-10. MCI



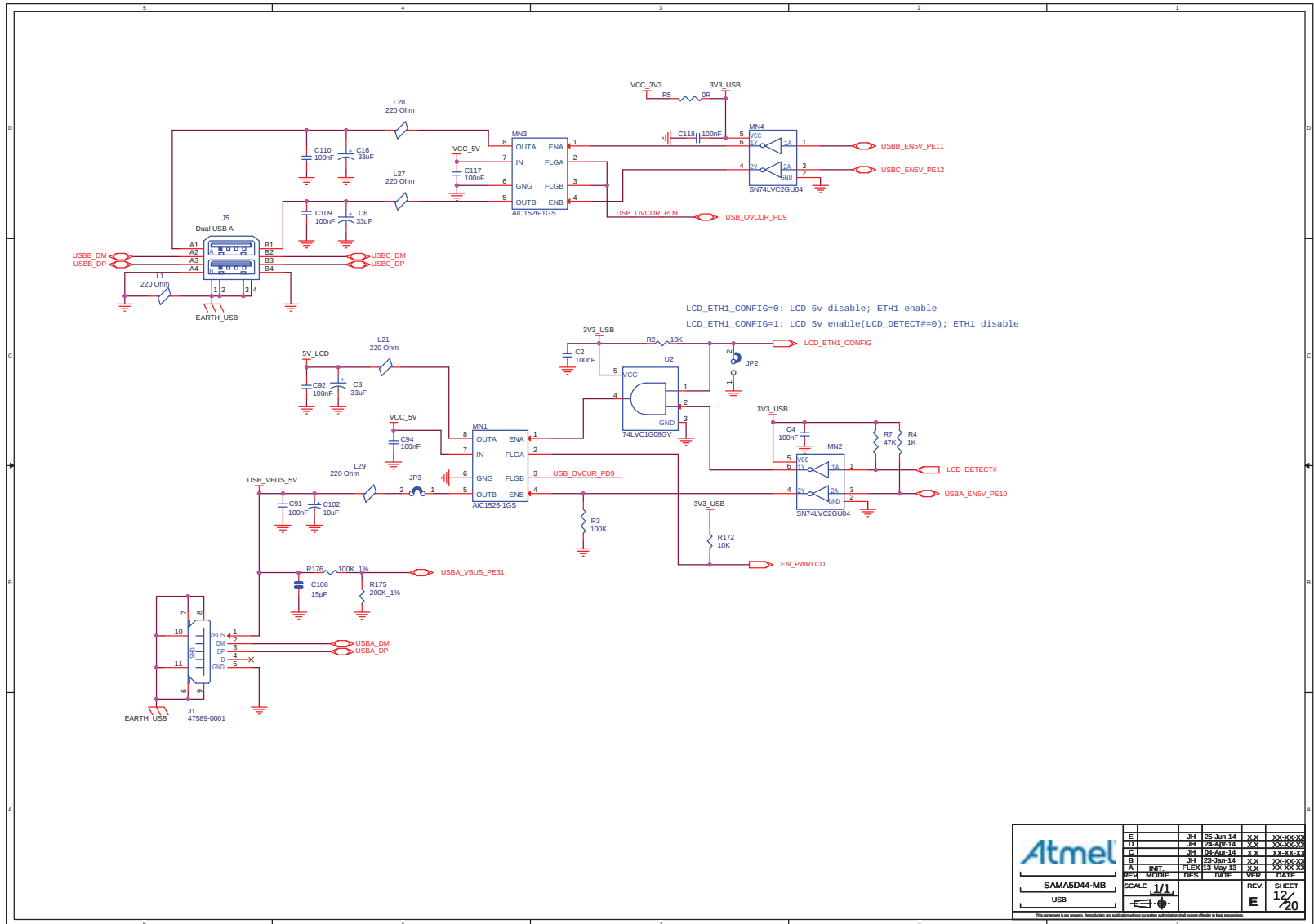


Figure 5-12. ETH0

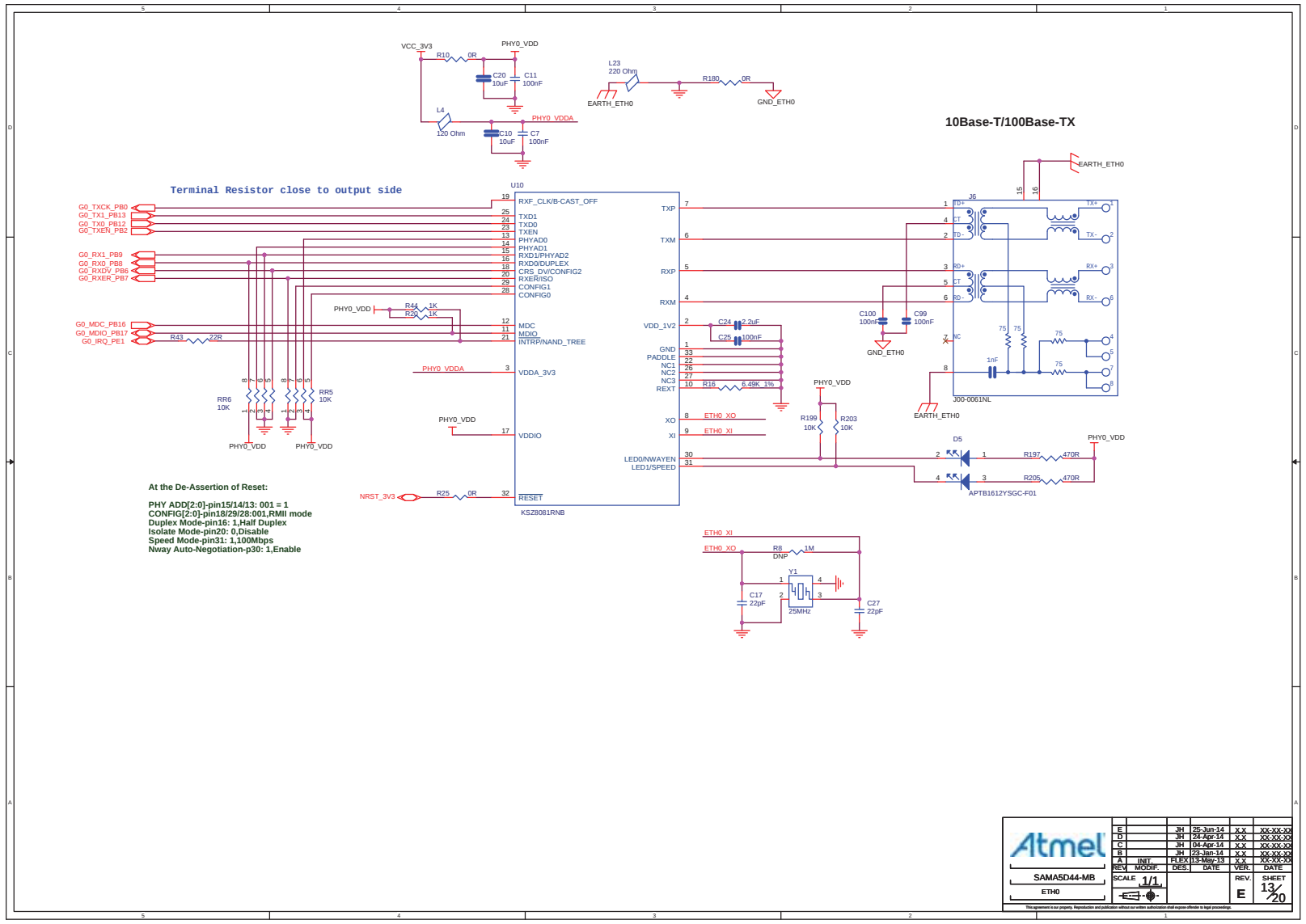
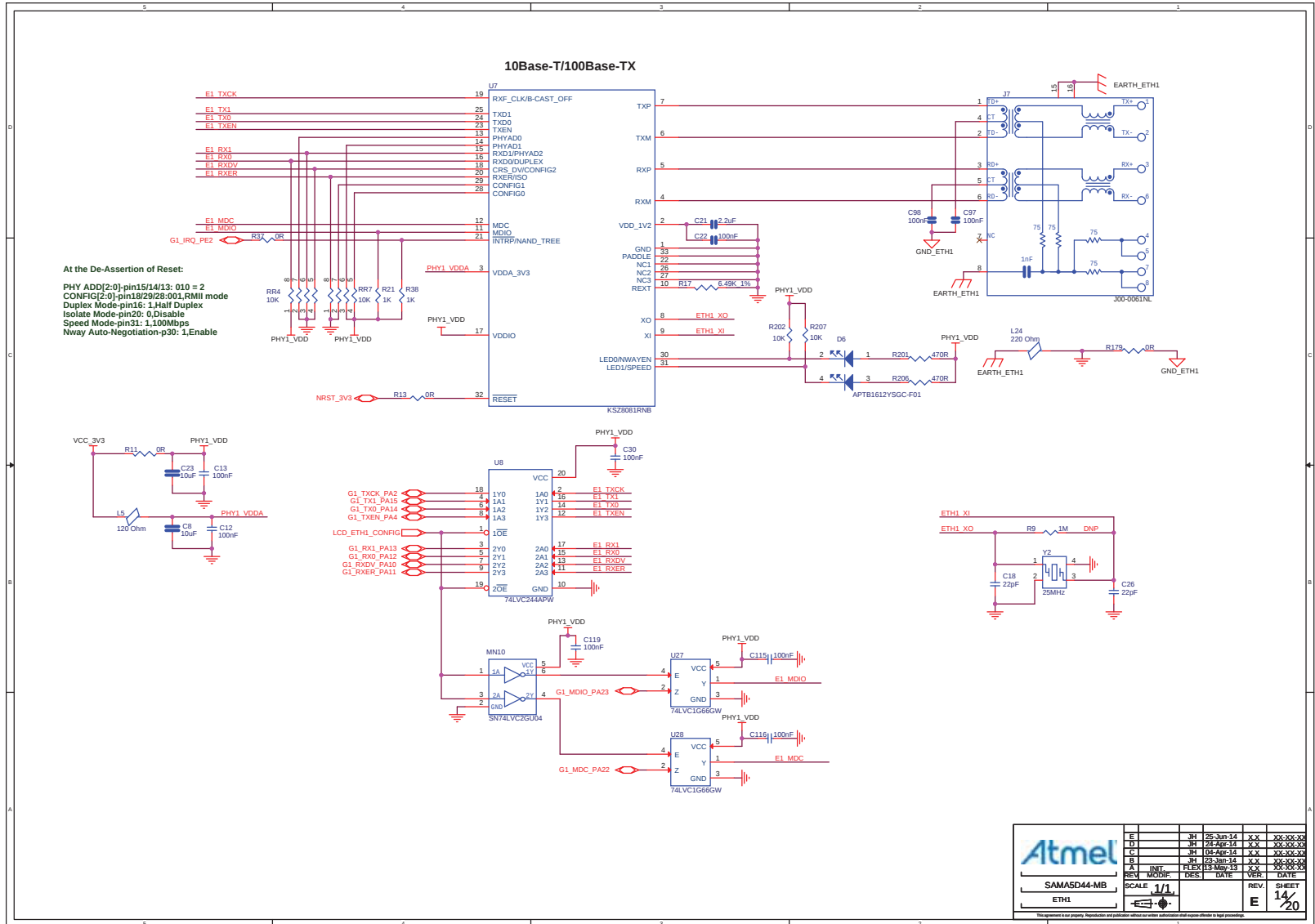
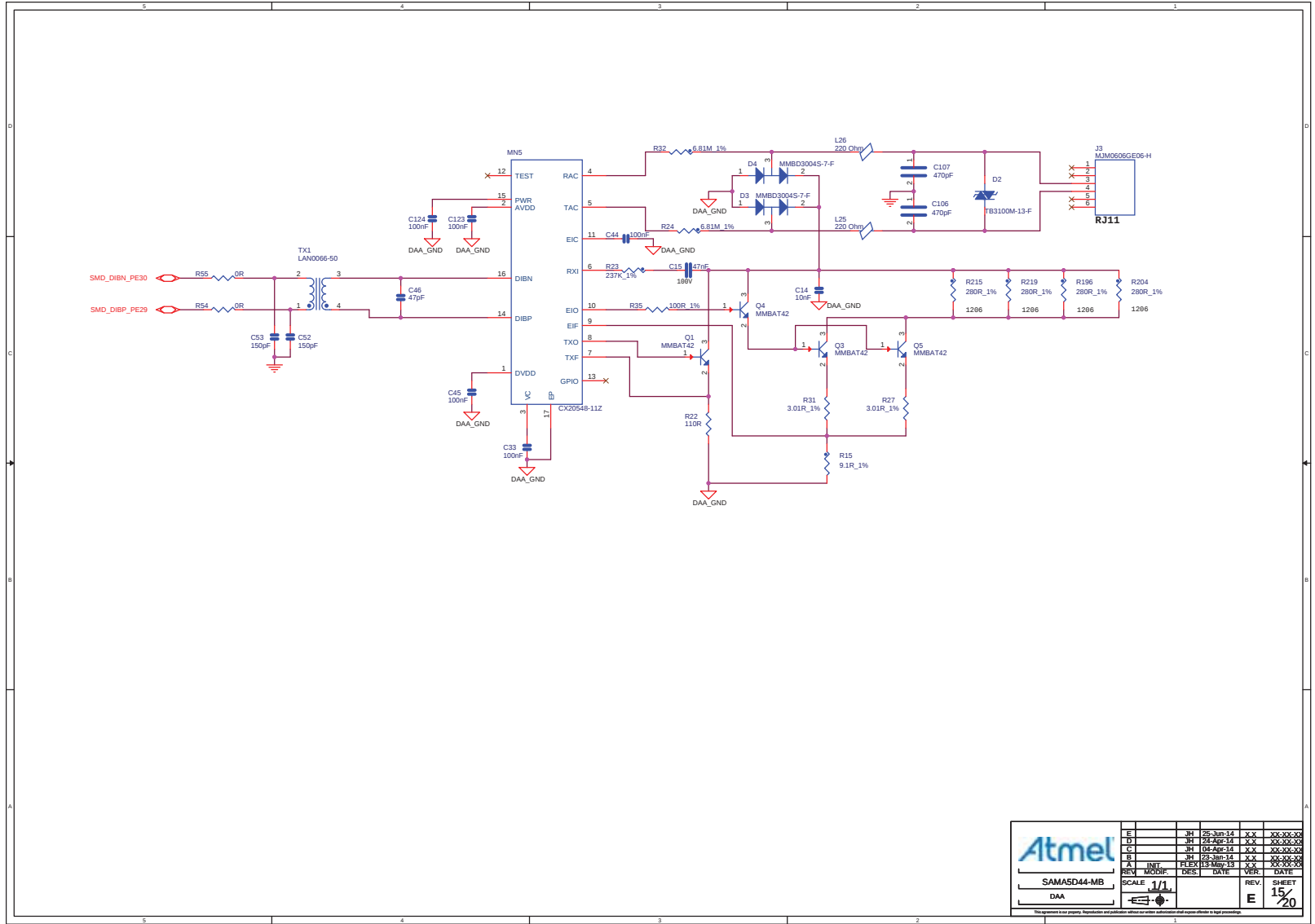


Figure 5-13. ETH1



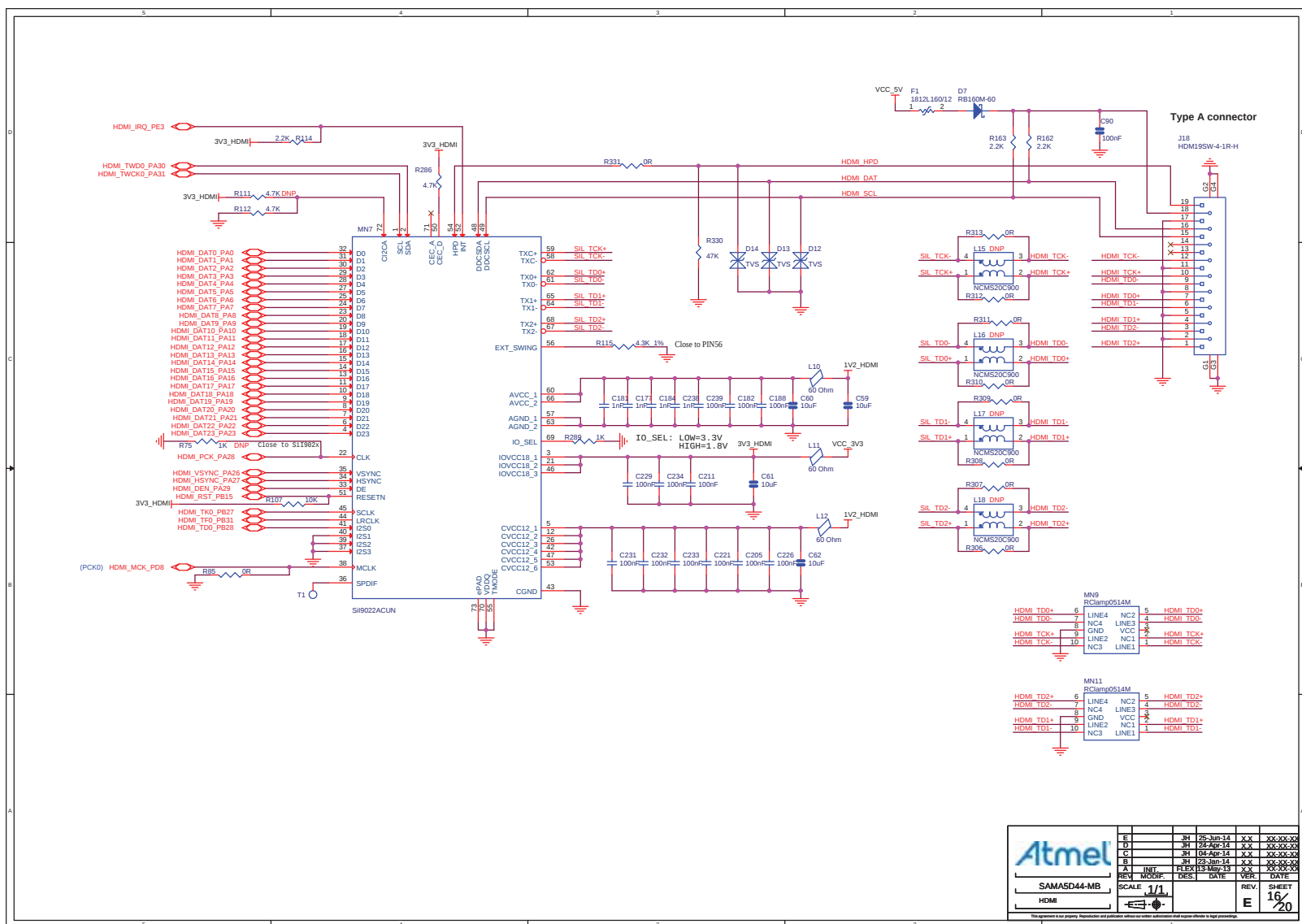
Atmel SAMA5D44-MB ETH1	E		31	25-Jun-14	X	X	XX-XX-XX
	D		31	24-Apr-14	X	X	XX-XX-XX
	C		31	09-Apr-14	X	X	XX-XX-XX
	B		31	23-Mar-14	X	X	XX-XX-XX
	A		31	13-May-13	X	X	XX-XX-XX
	REV	DATE	DATE	DATE	DATE	DATE	DATE
	SCALE	1/1					
	REV	E	14				
	SHEET	14	20				

Figure 5-14. DAA

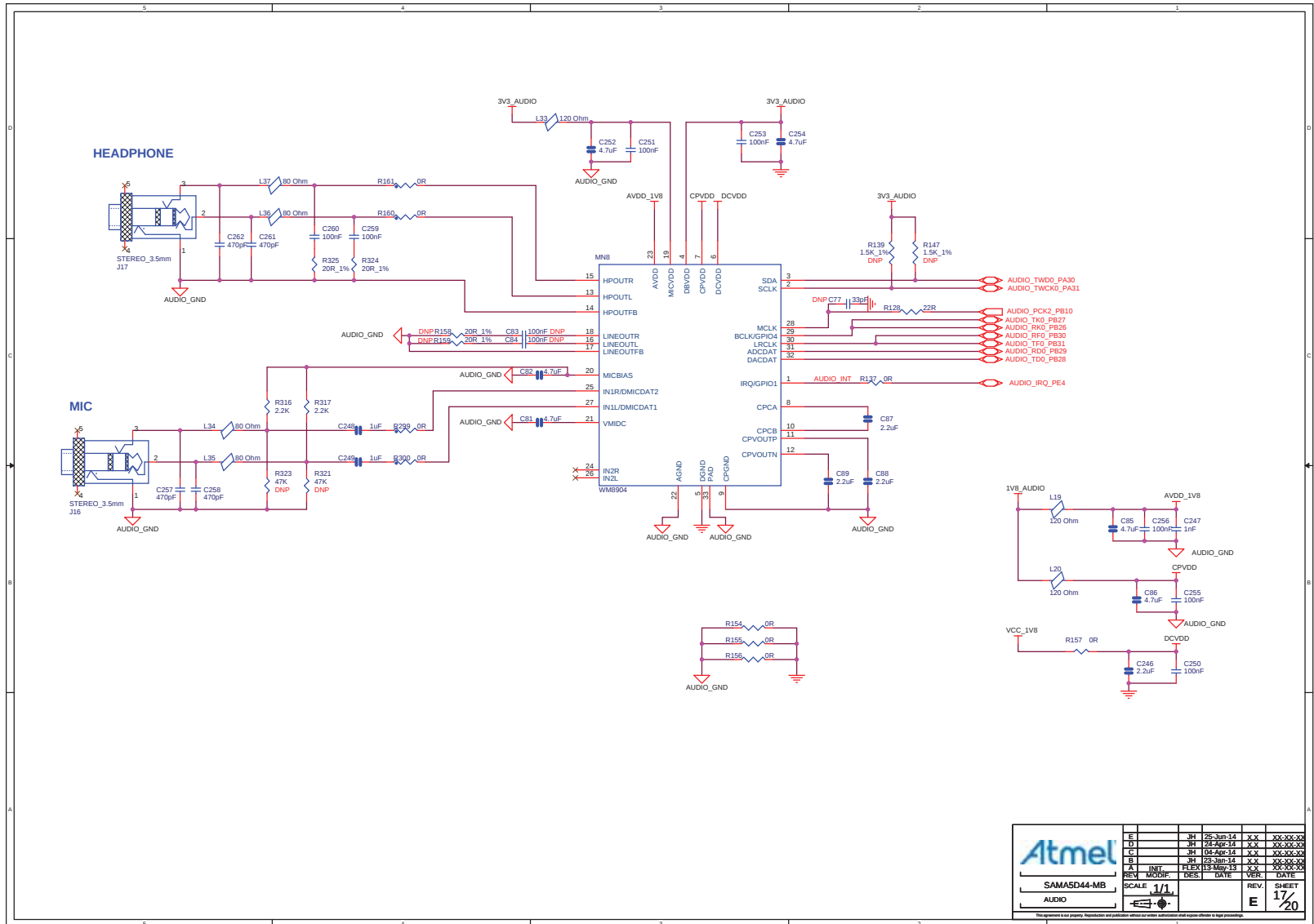


Atmel		SAMA5D44-MB		DAA	
REV	MODIF	DES	DATE	VER	DATE
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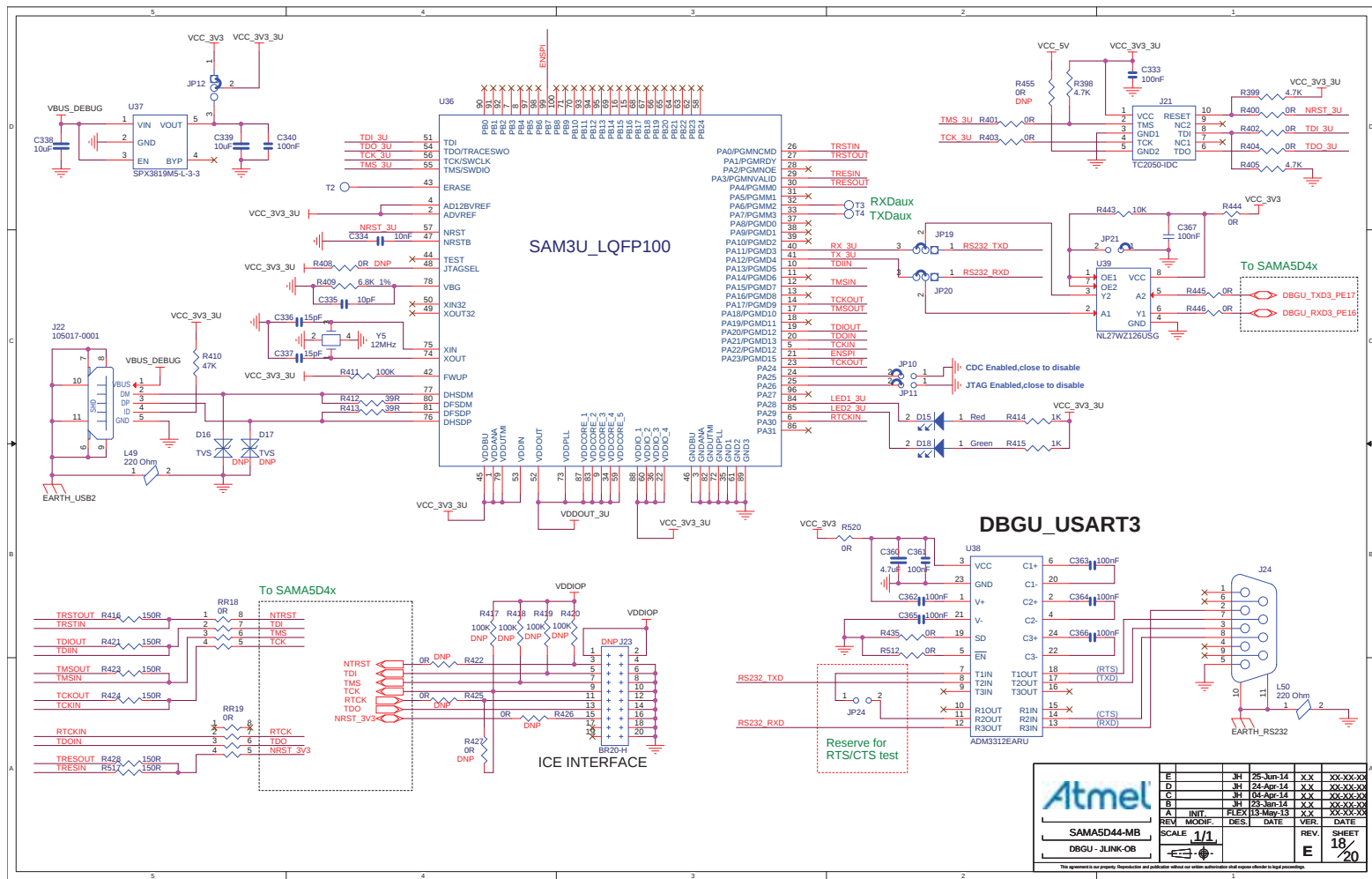


Figure 5-18. LCD, ISI I/F

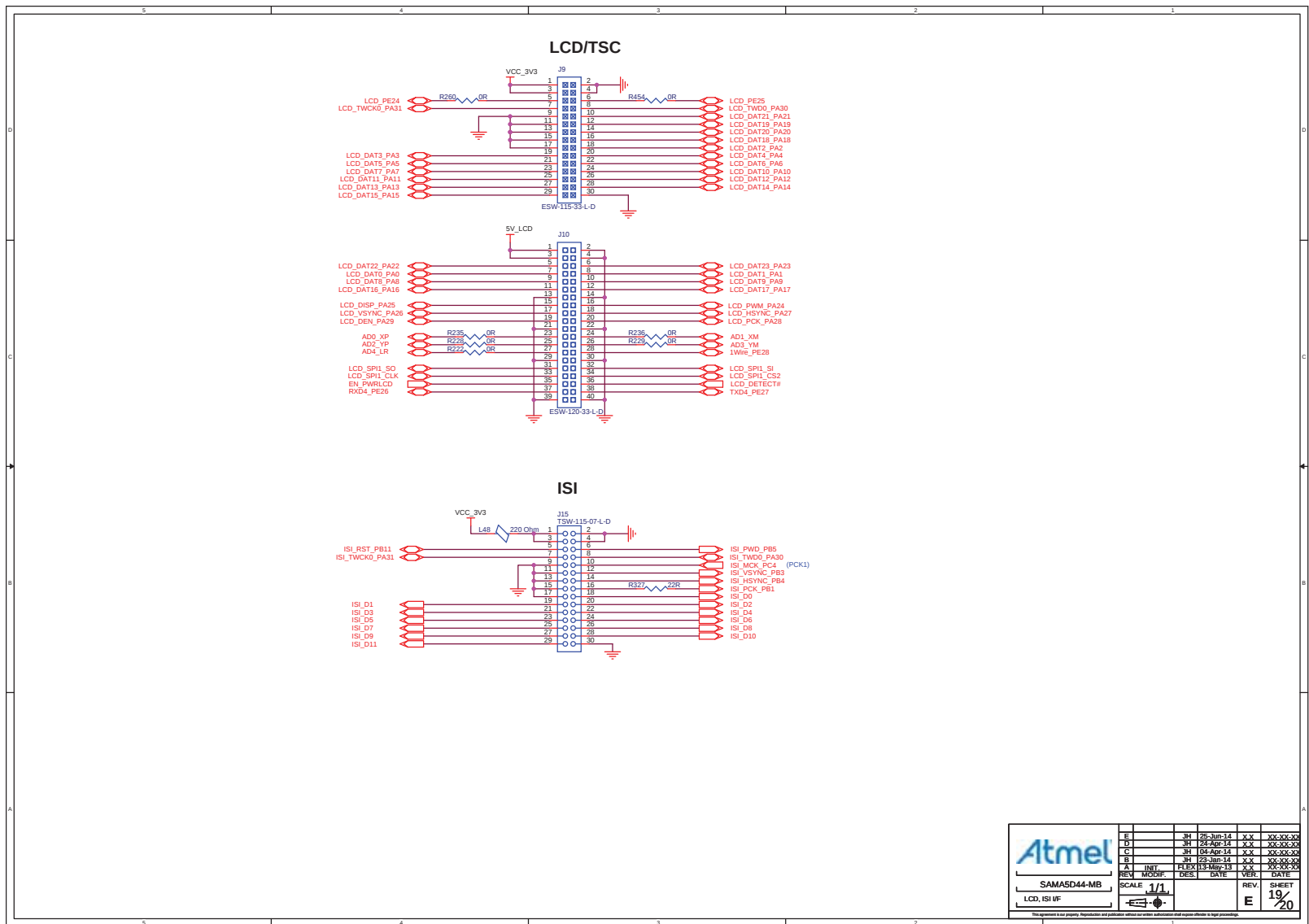
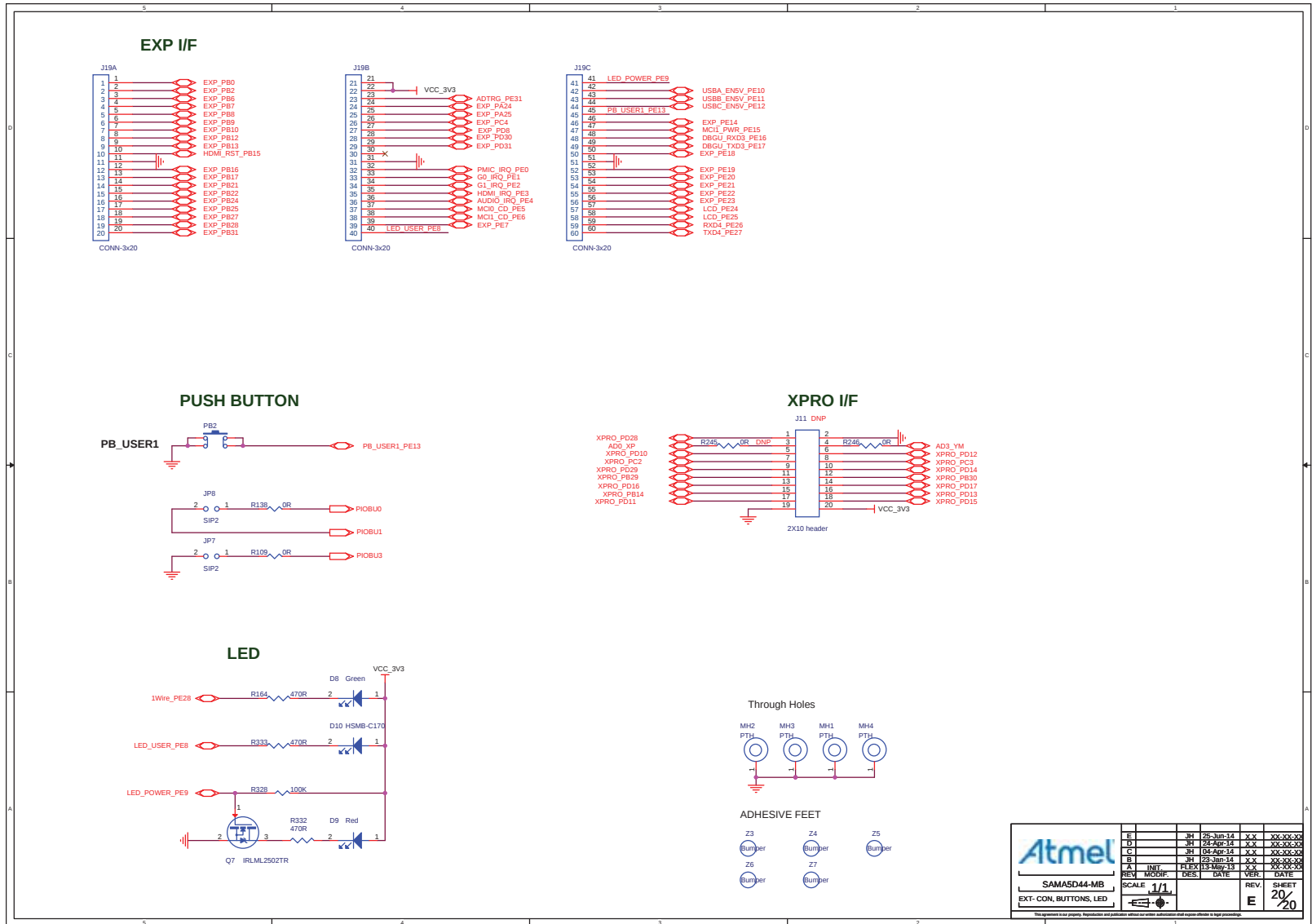


Figure 5-19. EXT - CON, Buttons, LED



6. Revision History

Table 6-1. SAMA5D4 Evaluation Kit User Guide Rev 11294C Revision History

Document	Comments
11294C	Updated Section 3.2.5 “SAMA5D4 Series Processor” Modified Section 3.2.7.1 “Power Lines” Modified Section 3.2.7.2 “Power-up and Power-down Considerations” (title and content)
11294B	Modified Section “IO Expansion Port” Modified Table 4-11 “XPro Socket J11 Signal Descriptions”
11294A	First issue



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