

SAM3X-EK

User Guide



Section 1

Introduction	1-1
1.1 SAM3X Evaluation Kit	1-1
1.2 User Guide	1-1
1.3 References and Applicable Documents	1-1

Section 2

Kit Contents	2-1
2.1 Deliverables	2-1
2.2 Electrostatic Warning	2-2

Section 3

Power Up	3-1
3.1 Power up the Board	3-1
3.2 Battery	3-1
3.3 DevStart	3-1
3.4 Recovery Procedure	3-1
3.5 Sample Code and Technical Support	3-2

Section 4

Evaluation Kit Hardware	4-1
4.1 Board Overview	4-1
4.2 Features List	4-2
4.3 Function Blocks	4-2
4.3.1 Processor	4-2
4.3.2 Memory	4-2
4.3.3 Clock Circuitry	4-4
4.3.4 Reset and Wake-Up Circuitry	4-4
4.3.5 Power Supply and Management	4-5
4.3.6 UART	4-6
4.3.7 USART	4-6
4.3.8 LEDs	4-7
4.3.9 LCD, Backlight Control and Touch Panel	4-8
4.3.10 JTAG/ICE	4-10
4.3.11 Audio Codec	4-10
4.3.12 USB	4-11
4.3.13 Analog Interface	4-12
4.3.14 User Buttons	4-13
4.3.15 QTouch Elements	4-13
4.3.16 EEPROM	4-14
4.3.17 SD Card	4-15

4.3.18	ZigBee	4-15
4.3.19	PIO Expansion	4-17
4.3.20	Ethernet MAC 10/100 (EMAC)	4-18
4.3.21	CAN	4-18
4.4	Configuration	4-19
4.4.1	PIO Usage	4-20
4.4.2	Jumpers	4-25
4.4.3	Test Points	4-26
4.4.4	Assigned PIO Lines, Disconnection Possibility	4-26

Section 5

Schematics	5-1
5.1 Schematics	5-1

Section 6

Troubleshooting	6-1
6.1 Self-Test	6-1
6.2 Board Recovery	6-1

Section 7

Revision History	7-1
7.1 Revision History	7-1

1.1 SAM3X Evaluation Kit

The SAM3X Evaluation Kit (SAM3X-EK) allows to evaluate the SAM3X series devices. It has enough features to demonstrate most of the product's capabilities to its users. The SAM3X-EK also features extension connectors to allow users to add new interfaces in case they are not on-board.

1.2 User Guide

This guide gives details on how the SAM3X-EK has been designed. It is made up of 6 sections:

- Section 1 includes references, applicable documents
- Section 2 describes the kit contents and main features
- Section 3 provides instructions on how to power up the SAM3X-EK and describes how to use it
- Section 4 describes the hardware resources, including default jumper and switch settings, and the schematics
- Section 5 provides all the board schematics
- Section 6 gives troubleshooting recommendations

1.3 References and Applicable Documents

Table 1-1. References and Applicable Documents

Title	Comment
SAM3X Datasheet	http://www.atmel.com/dyn/products/devices.asp?category_id=163&family_id=605&subfamily_id=2363

2.1 Deliverables

The Atmel® SAM3X-EK toolkit contains the following items:

- a SAM3X-EK board
- one power supply
- one universal input AC/DC power supply with US, Europe and UK plug adapters
- one 3V Lithium Battery type CR1225
- one USB cable
- one Micro A to Type A receptacle changer
- one serial RS232 cable
- one Ethernet cross cable
- A Welcome Letter

Figure 2-1. Unpacked SAM3X-EK



Unpack and inspect the kit carefully. Contact your local Atmel distributor, should you have issues concerning the contents of the kit.

2.2 Electrostatic Warning

The SAM3X-EK board is shipped in a protective anti-static bag. The board must not be subjected to high electrostatic potentials. A grounding strap or similar protective device should be worn when handling the board. Avoid touching the components or any other metallic element of the board.



3.1 Power up the Board

Unpack the board taking care to avoid electrostatic discharge. Unpack the power supply, select the right 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 board LCD should light up and display a welcome page. Then, click or touch icons displayed on the screen and enjoy the demo.

3.2 Battery

The SAM3X-EK ships with a 3V coin battery.

This battery is not required for the board to start up.

The coin battery is provided for user convenience in case the user would like to exercise the date and time backup function of the SAM3X series devices when the board is switched off.

3.3 DevStart

The on-board NAND Flash contains “SAM3X-EK DevStart”.

It is stored in the “SAM3X-EK DevStart” folder on the USB Flash disk available when the SAM3X-EK is connected to a host computer and you click on the Flash Disk icon of the on-board demo.

Click the file “welcome.html” in this folder to launch SAM3X-EK DevStart.

SAM3X-EK DevStart guides you through installation processes of IAR™ EWARM, Keil MDK and GNU toolkits. Then, it gives you step-by-step instructions on how to rebuild a single example project and how to program it into the SAM3X-EK. Optionally, if you have a SAM-ICE™, instructions are also given about how to debug the code.

We recommend that you backup the “SAM3X-EK DevStart” folder on your computer before launching it.

3.4 Recovery Procedure

The DevStart ends by giving step-by-step instructions on how to recover the SAM3X-EK to the state as it was when shipped by Atmel.

Follow the instructions if you deleted the contents of the embedded Flash or the NAND Flash and want to recover from this situation.

3.5 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 Atmel website: www.atmel.com

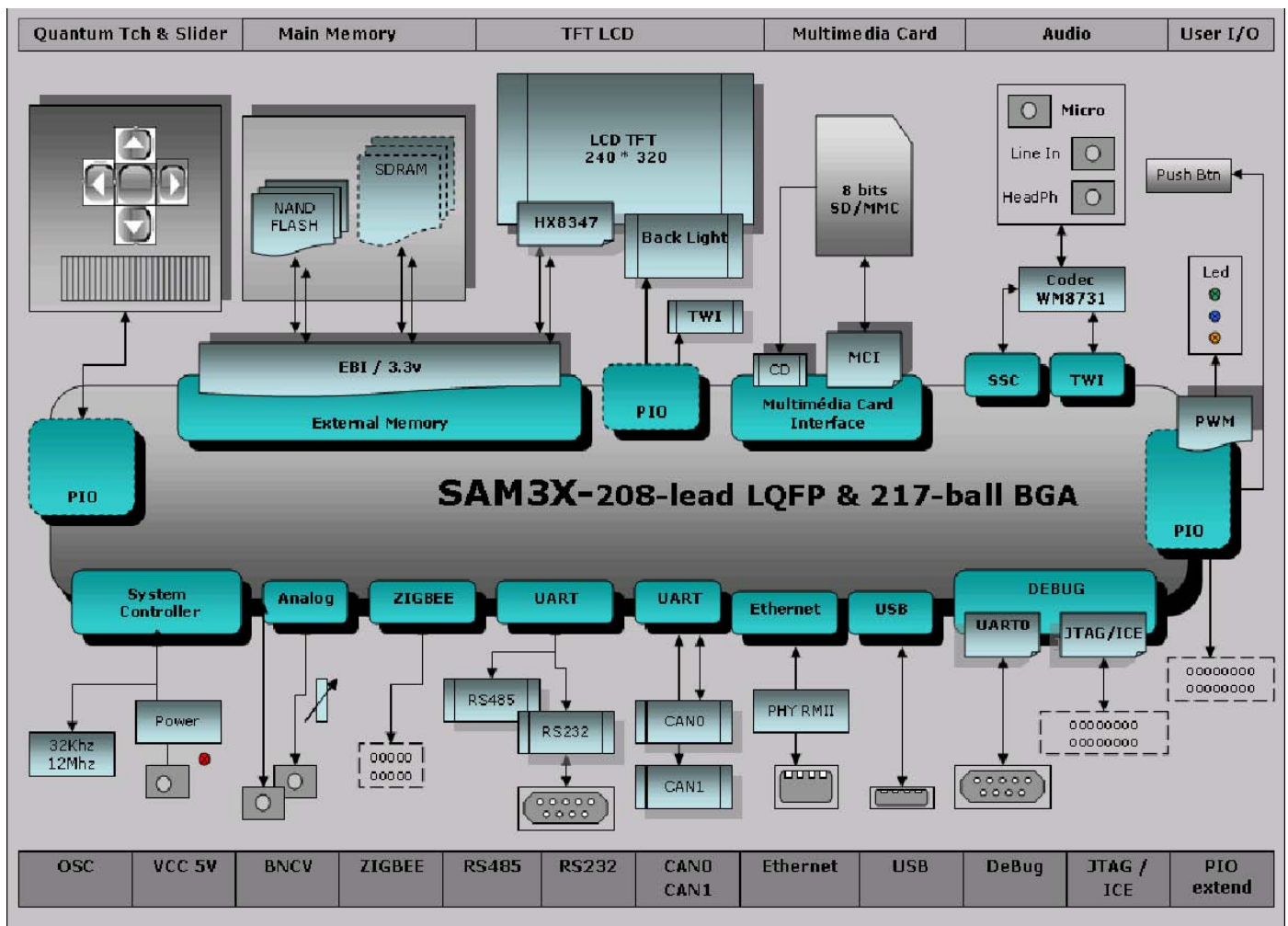
Evaluation Kit Hardware

4.1 Board Overview

This section introduces the Atmel SAM3X Evaluation Kit design. It introduces system-level concepts, such as power distribution, memory, and interface assignments.

The SAM3X-EK board is based on the integration of an ARM® Cortex®-M3 processor with on-board SDRAM, NAND-Flash and a set of popular peripherals. It is designed to provide a high performance processor evaluation solution with high flexibility for various kinds of applications.

Figure 4-1. SAM3X-EK Block Diagram



4.2 Features List

Here is the list of the main board components and interfaces:

- SAM3X8H LFBGA chip with optional socket footprint
- 12 MHz crystal
- 32.768 KHz crystal
- SDRAM
- NAND-Flash
- Backup Battery
- 2.8 inch TFT color LCD display with touch-panel and backlight
- UART port with level shifter IC
- USART port with level shifter IC
- Audio codec with input and output jacks: stereo headphone out and mono microphone in
- SD/MMC interface
- QTouch elements: Up, Down, Left, Right, Valid and Slider
- Reset and Wake-Up buttons: NRST, NRSTB, FWUP
- User buttons: Left and Right
- High Speed USB Host/Device port
- JTAG/ICE port
- On-board power regulation with shutdown control (by the SAM3 chip)
- Three user LEDs
- Power LED
- User potentiometer connected to the ADC input
- IEEE 802.15.4 / ZigBee® connector
- Two serial CAN 2.0B communication port via two RJ12 connectors
- One Ethernet Physical Transceiver Layer with RJ45 connector
- Five peripheral Input/Output Extension Connectors HE10 (PIOA, B, C, D, E)

4.3 Function Blocks

4.3.1 Processor

The SAM3X-EK is equipped with a SAM3X8H in a LFBGA217 package.

4.3.2 Memory

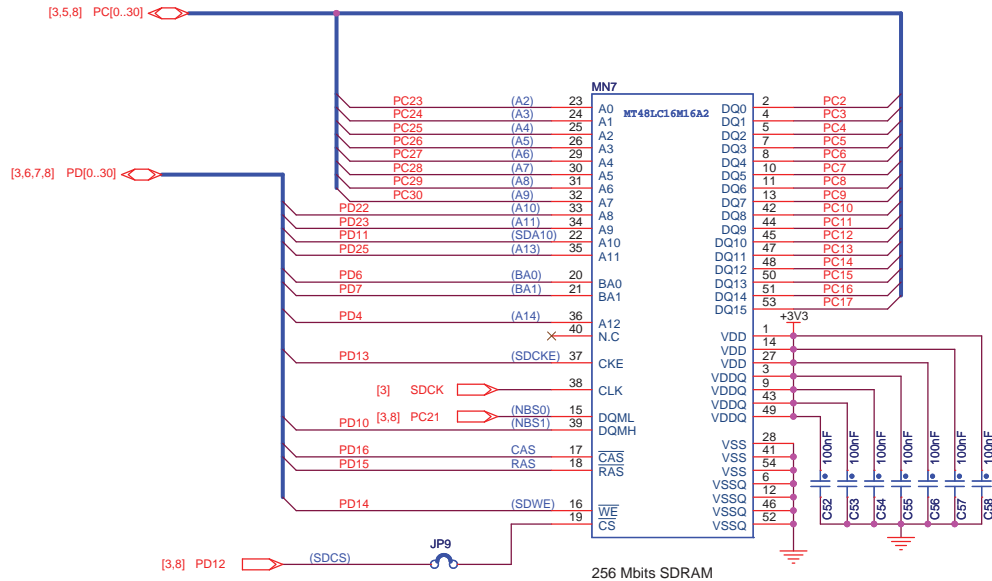
The SAM3X8H chip embeds:

- 512 Kbytes of embedded Flash
- 100Kbytes of embedded SRAM with dual bank
- 16 Kbytes of ROM with embedded bootloader routines (UART, USB) and IAP (In-Application Programming functions) routines.

The SAM3X8H features an External Bus Interface (EBI) that permits interfacing to a broad range of external memories and virtually any parallel peripheral. The SAM3X-EK board is equipped with two kinds of memory devices connected to the SAM3X8H EBI:

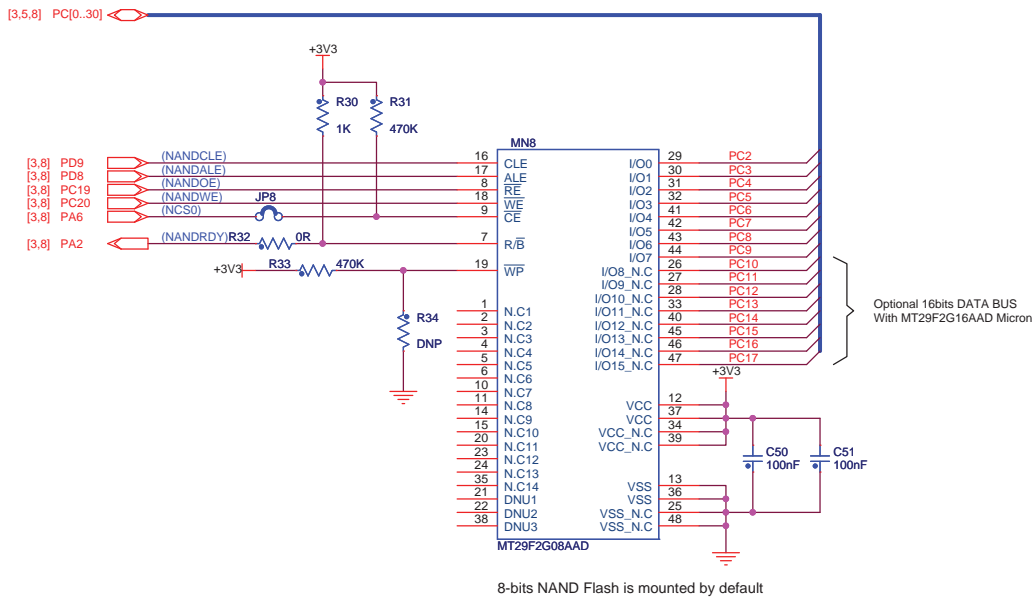
- One 4Mega x16 x4 banks SDRAM device⁽¹⁾
- One NAND-Flash MT29F2G08AAD.

Figure 4-2. SDRAM



Note: 1. Brand and reference may vary. Check the bill of material (BOM) corresponding to your kit version to get precise information regarding that matter.

Figure 4-3. NAND-Flash



8-bits NAND Flash is mounted by default

The chip select signals SDCS and NCS0 are used for SDRAM and NAND-Flash chips selection, respectively. Furthermore, a dedicated jumper can disconnect these from the memories, to let SDCS and NCS0 be used for other custom purpose.

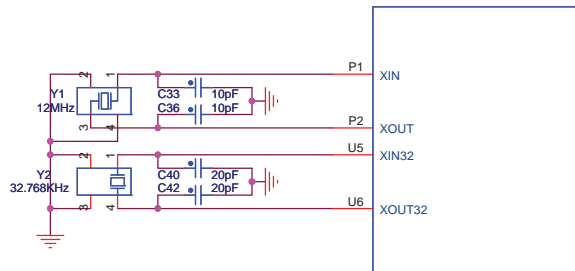
4.3.3 Clock Circuitry

The clock generator of a SAM3X8H microcontroller is made up of:

- A Low Power 32,768 Hz Slow Clock Oscillator with bypass mode
- A 3 to 20 MHz Crystal Oscillator, which can be bypassed (12 MHz needed in case of USB)
- High precision 8/12 MHz factory trimmed internal RC oscillator with 4 MHz Default Frequency for fast device startup
- A 480 MHz UTMI PLL providing a clock for the USB High Speed Controller
- A 96 to 192 MHz programmable PLL (input from 8 to 16 MHz), capable of providing the clock MCK to the processor and to the peripherals.

The SAM3X-EK board is equipped with one 12 MHz crystal, one 32,768 Hz crystal.

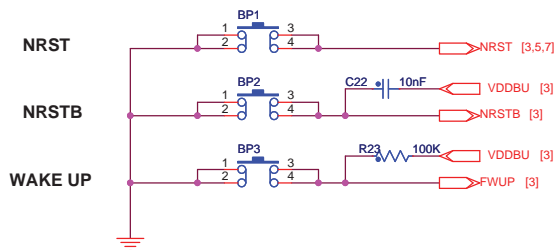
Figure 4-4. External Clock Source



4.3.4 Reset and Wake-Up Circuitry

The on-board NRST button BP1 and NRSTB button BP2 provide the SAM3X8H with external reset control. The on-board WAKE-UP button BP3 can be used to wake up the chip from low power modes.

Figure 4-5. System Buttons



The NRST pin is bidirectional. It is handled by the on-chip reset controller and can be driven low to provide a reset signal to the external components, or asserted low externally to reset the microcontroller. It will reset the Core and the peripherals except the Backup region (RTC, RTT and Supply Controller). There is no constraint on the length of the reset pulse, in any case the reset controller guarantee a minimum pulse length. The NRST pin integrates a permanent pull-up resistor to VDDIO of about 100 k Ω .

On the SAM3X-EK board, the NRST signal is connected to the LCD module, JTAG port and Ethernet Physical Transceiver.

The NRSTB pin is input only and enables asynchronous reset of the SAM3X/A series when asserted low. The NRSTB pin integrates a permanent pull-up resistor of about 15 k Ω . This allows connection



of a simple push button on the NRSTB pin as a system-user reset. In all modes, this pin will reset the chip including the Backup region (RTC, RTT and Supply Controller). It reacts as the Power-on reset. It can be used as an external system reset source. In harsh environments, it is recommended to add an external capacitor (10 nF) between NRSTB and VDDBU. (For filtering values, refer to “I/O characteristics” in the “Electrical Characteristics” section of the product datasheet) The NRSTB input has an embedded anti-glitch filtering system.

The FWUP pin is enabled as a wake up source by writing the FWUPEN bit to 1 in the Supply Controller Wake Up Mode Register (SUPC_WUMR). Then, the FWUPDBC field in the same register selects the debouncing period, which can be selected between 3, 32, 512, 4,096 or 32,768 slow clock cycles. This corresponds respectively to about 100 μs, about 1 ms, about 16 ms, about 128 ms and about 1 second (for a typical slow clock frequency of 32 kHz). Programming FWUPDBC to 0x0 selects an immediate wake up, i.e., the FWUP must be low during a minimum of one slow clock period to wake up the core power supply. If the FWUP pin is asserted for a time longer than the debouncing period, a wake up of the core power supply is started and the FWUP bit in the Supply Controller Status Register (SUPC_SR) is set and remains high until the register is read.

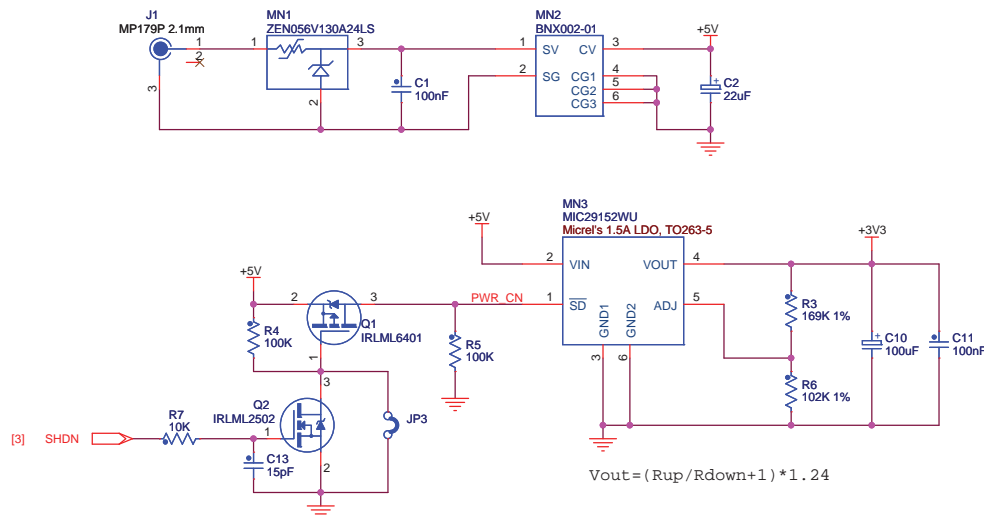
4.3.5 Power Supply and Management

The SAM3X-EK board is supplied with an external 5V DC block through input J1. A protection circuitry is obtained by a PolyZen diode MN1 and an LC combinatory filter MN2.

The adjustable LDO regulator MN3 is employed for the main supply of the 3.3V rail. It powers all the 3.3V board components. The shut down control of this LDO is made by MOSFETs Q1, Q2 piloted by the SAM3X8H SHDN pin. When SAM3X8H is in backup mode, SHDN pin outputs a low level signal, which shuts down the LDO. When the device is running (not in backup mode), SHDN pin outputs a high level signal, which enables the LDO.

By closing the “FORCE POWER ON” jumper JP3, the P-channel MOSFET Q1 will be forced on, no matter the level present on the SHDN pin, and the LDO 3.3V output will thereby be forced active.

Figure 4-6. Power Block



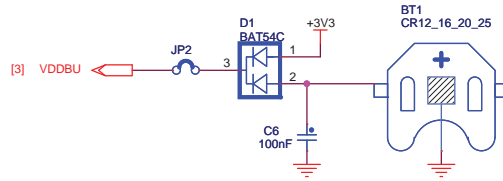
The SAM3X-EK board uses the 3.3V LDO output as its main supply source. VDDUTMI, VDDANA, VDDIO, VDDIN are powered directly from that source.

The internal 1.8V regulator output feeds VDDCORE and VDDPLL.

VDDCORE and VDDPLL can also be powered by an external supply. (Refer to the SAM3X datasheet for more details).

VDDBU pin is powered from the 3.3V rail and a backup battery BT1 via a dual Schottky diode D1.

Figure 4-7. Backup Battery

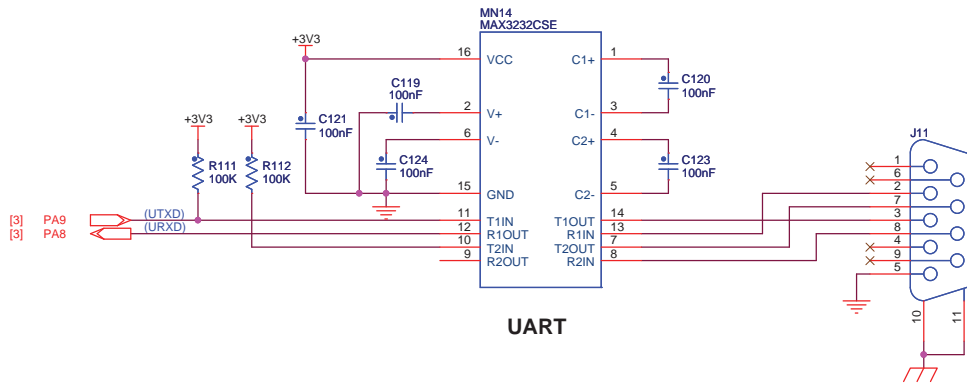


4.3.6 UART

The Universal Asynchronous Receiver Transmitter features a two-pin UART that can be used for communication and trace purposes and offers an ideal medium for on-site programming solutions. Moreover, the association with two peripheral DMA controller (PDC) channels permits packet handling for these tasks with processor time reduced to a minimum.

This two-pin UART (TXD and RXD only) is buffered through an RS232 Transceiver MN14 and brought to the DB9 male connector J11.

Figure 4-8. UART



4.3.7 USART

The Universal Synchronous Asynchronous Receiver Transceiver (USART) provides one full duplex universal synchronous asynchronous serial link. Data frame format is widely programmable (data length, parity, number of stop bits) to support a maximum of standards. The receiver implements parity error, framing error and overrun error detection. The receiver time-out enables handling variable-length frames and the transmitter timeguard facilitates communications with slow remote devices. Multidrop communications are also supported through address bit handling in reception and transmission.

The USART features three test modes: remote loopback, local loopback and automatic echo.

The USART supports specific operating modes providing interfaces on RS485, LIN and SPI buses, with ISO7816 T = 0 or T = 1 smart card slots and infrared transceivers. The hardware handshaking feature enables an out-of-band flow control by automatic management of the pins RTS and CTS.

The USART supports the connection to the Peripheral DMA Controller, which enables data transfers to the transmitter and from the receiver. The PDC provides chained buffer management without any intervention of the processor.

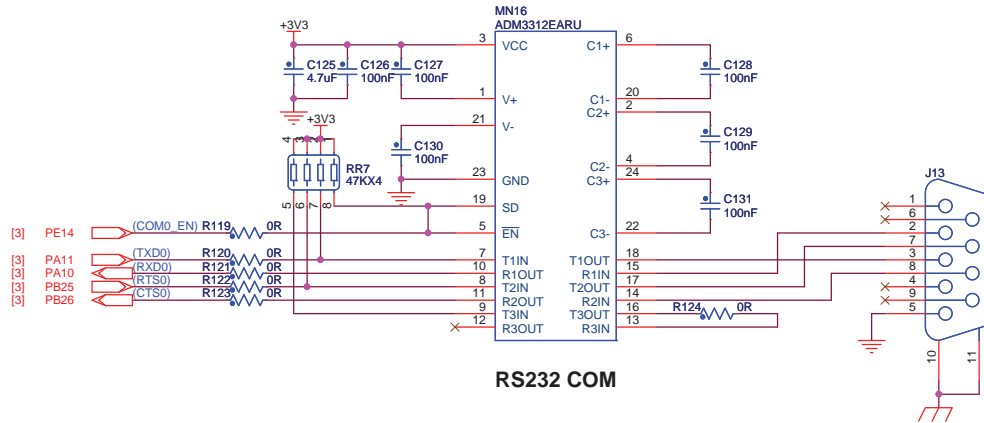


There are 4 USARTs on the SAM3X8H device.

4.3.7.1 RS232

SAM3X-EK connects the USART0 bus (including TXD, RXD, RTS, CTS handshake signals control) to the DB9 male connector J13 through the RS232 Transceiver MN16.

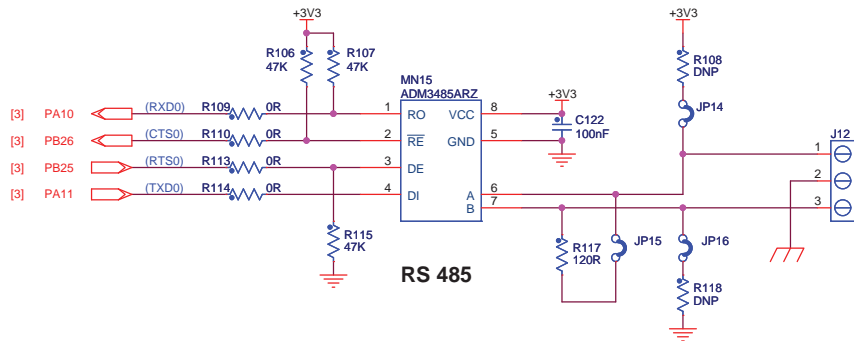
Figure 4-9. RS232



4.3.7.2 RS485

As noticed above, the USART0 is shared with the RS485 port, connected to the transceiver MN15, connected to the 3-point connector J12. The design includes selectable jumpers for RS485 bus termination resistors selection (JP14, JP15 and JP16).

Figure 4-10. RS485



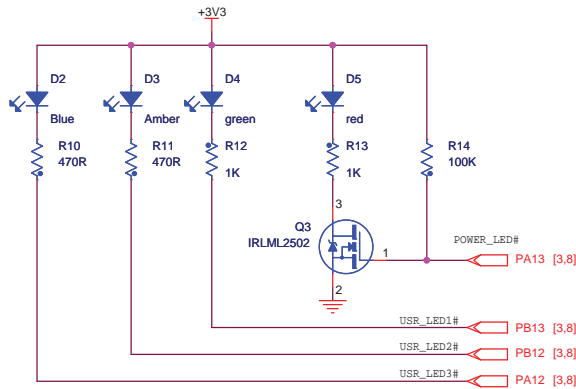
4.3.8 LEDs

There are four LEDs on the SAM3X-EK board:

- D2 blue, D3 amber and D4 green LEDs are user defined and controlled by the GPIO.
- D5 red LED is a power LED indicating that the 3.3V rail is enabled. It can also be controlled by the GPIO (by default, the GPIO is disabled and an on-board pull-up to 3.3V lights the LED).



Figure 4-11. LEDs



4.3.9 LCD, Backlight Control and Touch Panel

SAM3X-EK carries one TFT/Transmissive LCD module with touch screen, FTM280C12D, with integrated driver IC HX8347. The LCD display size is 2.8 inches, with a native resolution of 240 x 320 pixels.

4.3.9.1 LCD Module

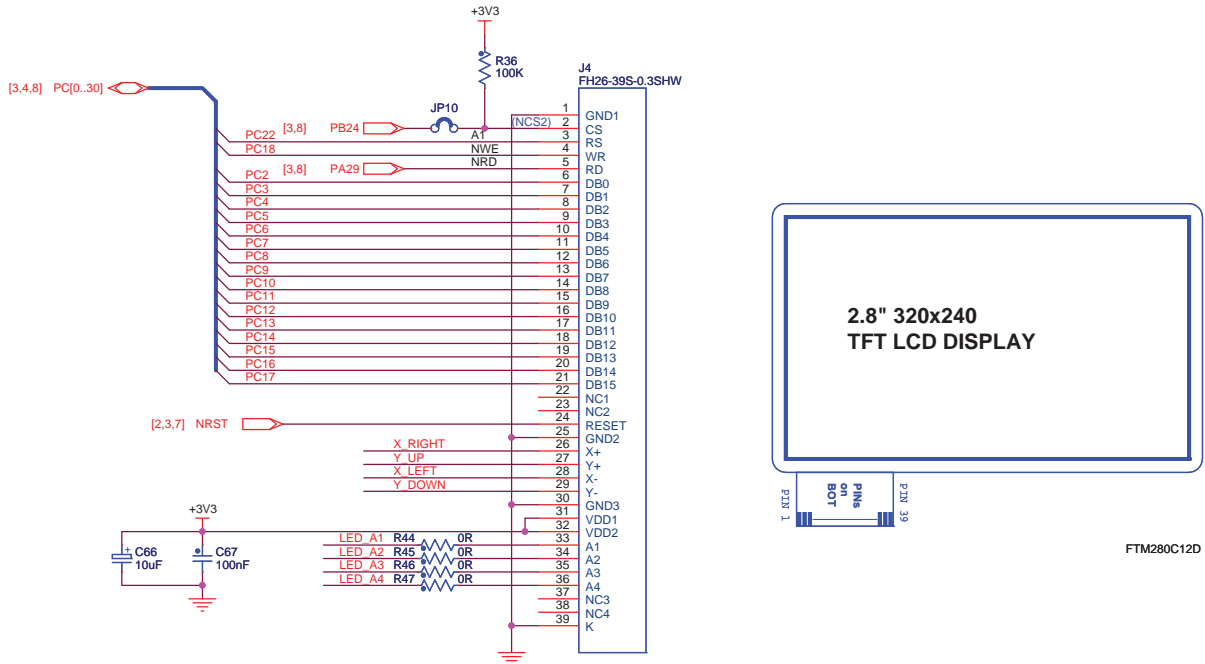
Table 4-1. LCD Module Pin Out

Pin	Symbol	Function
1	GND	Ground
2	CS	Chip Select
3	RS	Register select signal
4	WR	Write operation signal
5	RD	Read operation signal
6~21	DB0~DB15	Data bus
22~23	NC	No connection
24	RESET	Reset signal
25	GND	Ground
26	X+	Touch panel X_RIGHT
27	Y+	Touch panel Y_UP
28	X-	Touch panel X_LEFT
29	Y-	Touch panel Y_DOWN
30	GND	Ground
31	VDD1	Power supply for digital IO Pad
32	VDD2	Power supply for analog circuit
33~36	A1~A4	Power supply for backlight
37~38	NC	No connection
39	K	Backlight ground

The LCD module gets its reset from NRST. As explained previously, this NRST is shared with the JTAG port and the push button BP1. The LCD chip select signal is connected to NCS2 (a dedicated jumper can disable it, making NCS2 available for other custom usage).

The SAM3X8H communicates with the LCD through PIOC where a 16-bit parallel “8080-like” protocol data bus has to be implemented by software.

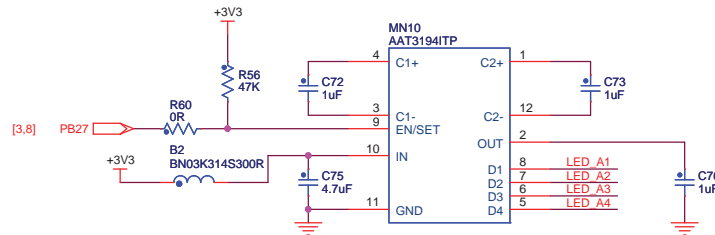
Figure 4-12. LCD Block



4.3.9.2 Backlight Control

LCD backlight is made of 4 white chip LEDs in parallel, driven by an AAT3194 charge pump, MN10. The AAT3194 is controlled by the SAM3X8H through a single line Simple Serial Control (S2Cwire) interface, which permits to enable, disable, and set the LED drive current (LED brightness control) from a 32-level logarithmic scale. Four 0-Ohm resistors R44/R45/R46/R47 are implemented for optional current limitation (replace 0 Ohm with the required resistor value).

Figure 4-13. Backlight Control



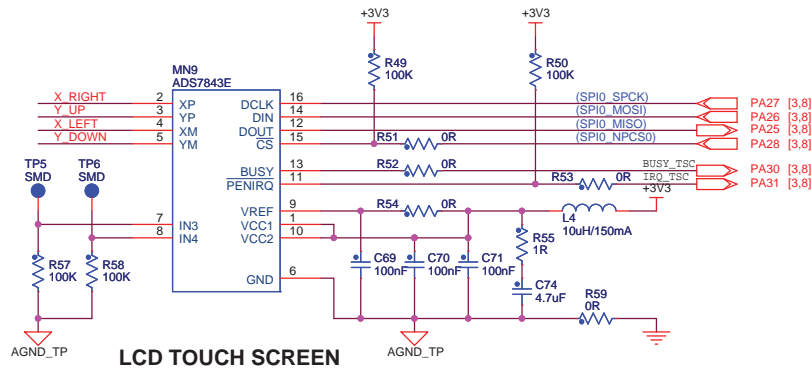
4.3.9.3 Touch Screen Interface

The LCD module integrates a 4-wire touch screen panel controlled by MN9, ADS7843, which is a slave device on the SAM3X8H SPI bus.

The ADS7843 touch ADC auxiliary inputs IN3/IN4 are connected to test points for optional function extension.



Figure 4-14. Touch Screen Controller

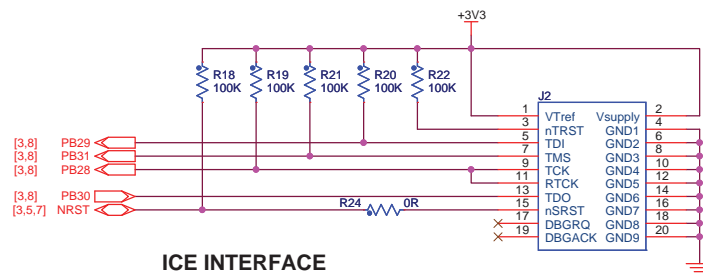


4.3.10 JTAG/ICE

A standard 20-pin JTAG connector is implemented on the SAM3X-EK for any ARM JTAG emulator connection, such as SAM-ICE from Segger.

Note that the NRST net is connected to the system button BP1, and is also used to reset the LCD module. 0-Ohm resistor R24 may be removed in order to isolate the JTAG port from the system reset signal.

Figure 4-15. JTAG Connector



4.3.11 Audio Codec

The SAM3X-EK includes a WOLFSON codec WM8731 for digital sound input and output. This interface includes audio jacks for:

- microphone input
- headphone output

The SAM3X8H programmable clock output is used to generate the WM8731 master clock (MCLK). The SAM3X8H ODT (On-Die Termination) feature guarantees a signal integrity on this clock line without the need for external discrete components.

WM8731 pin 21 MODE is pulled down by default; this configures the device as a TWI device for internal register access.

Pin15 CSB is pulled up, which sets its TWI address as 33 [0x0011011].

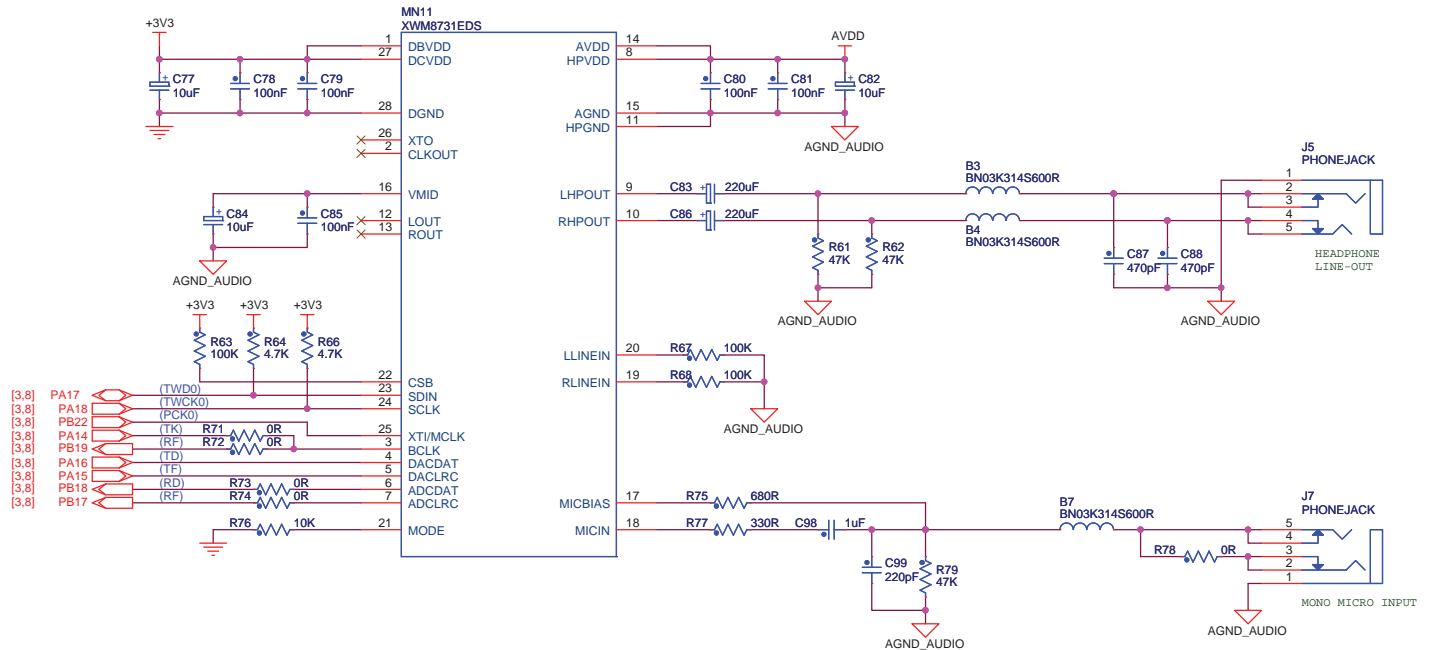
The WM8731 digital interface works in slave mode on the SAM3X8H Synchronous Serial Controller (SSC) interface, which means that Codec digital audio bit clock and ADC/DAC left/right control clock are to be generated by the SAM3X8H.

The WM8731 ADC and DAC have separated left/right control clocks to run at different rates.

The bit clock is shared; it can be the SSC transmitter clock (TK) or the receiver clock (RK). The default setting on SAM3X-EK is TK and RK shorted together through R71/R72. Please note that trying different ADC/DAC rates would mean different RK/TK rates; this default setting can be modified.

The 0-Ohm resistors R71/R72/R73/R74 have been implemented to offer a disconnection possibility (freeing these dedicated PIO lines for other custom usage).

Figure 4-16. Codec Block



4.3.12 USB

The SAM3X8H USB port is compliant with the Universal Serial Bus (USB) rev 2.0 specification at all speeds. J3 is a micro AB-type receptacle for USB Host/Device.

Both R25 and R26 39-Ohm resistors build up a 90-Ohm differential impedance together with the 5-Ohm output impedance of the Hi-speed channel drivers.

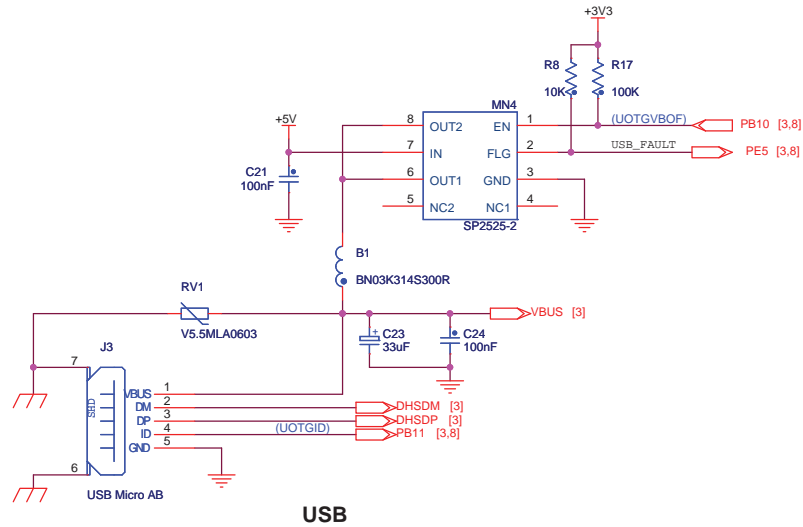
MN4 build up a power controller to guarantee the mode of USB can be switched between Device and Host mode.

Table 4-2. I/O Lines Description

Pin Name	Pin Description	Type	Active Level
UOTGVBOF	USB VBus On/Off: Bus Power Control Port	Output	VBUSPO
VBUS	VBus: Bus Power Measurement Port	Input	
D-	Data -: Differential Data Line - Port	Input/Output	
D+	Data +: Differential Data Line + Port	Input/Output	
DFSDM	FS Data -: Full-Speed Differential Data Line - Port	Input/Output	
DFSDP	FS Data +: Full-Speed Differential Data Line + Port	Input/Output	

Pin Name	Pin Description	Type	Active Level
DHSDM	HS Data -: Hi-Speed Differential Data Line - Port	Input/Output	
DHSDP	HS Data +: Hi-Speed Differential Data Line + Port	Input/Output	
UOTGID	USB Identification: Mini Connector Identification Port	Input	Low: Mini-A plug High Z: Mini-B plug

Figure 4-17. USB Block

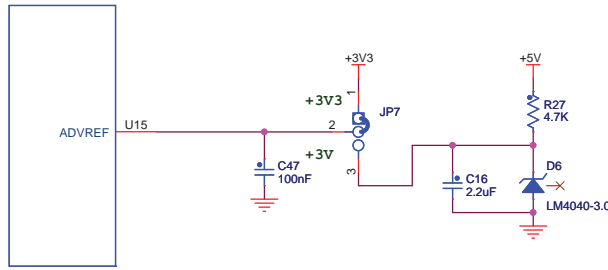


Pin Name	Pin Description	Type	Active Level
UOTGVBOF	USB VBus On/Off: Bus Power Control Port	Output	VBUSPO
VBUS	VBus: Bus Power Measurement Port	Input	
D-	Data -: Differential Data Line - Port	Input/Output	
D+	Data +: Differential Data Line + Port	Input/Output	
DFSDM	FS Data -: Full-Speed Differential Data Line - Port	Input/Output	
DFSDP	FS Data +: Full-Speed Differential Data Line + Port	Input/Output	
DHSDM	HS Data -: Hi-Speed Differential Data Line - Port	Input/Output	
DHSDP	HS Data +: Hi-Speed Differential Data Line + Port	Input/Output	
UOTGID	USB Identification: Mini Connector Identification Port	Input	Low: Mini-A plug High Z: Mini-B plug

4.3.13 Analog Interface

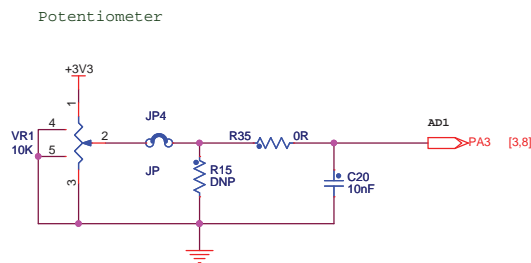
The 3.0V voltage reference is based on an LM4040 (Precision Micropower Shunt Voltage Reference). This ADVREF level can be set as 3.0V or 3.3V via the jumper JP7.

Figure 4-18. Analog VREF



A 10 KOhm potentiometer (VR1) is connected to ADC1 port PA3 to implement an easy access to ADC programming and debugging(or implement an analog user control such as display brightness, volume, etc.).

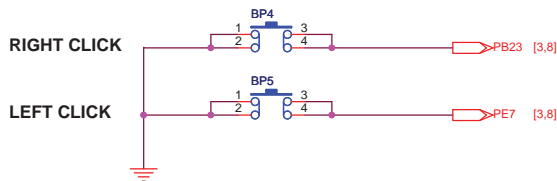
Figure 4-19. ADC Input



4.3.14 User Buttons

There are two mechanical user buttons on the SAM3X-EK, which are connected to PIO lines and defined to be "left" and "right" buttons by default.

Figure 4-20. User Buttons



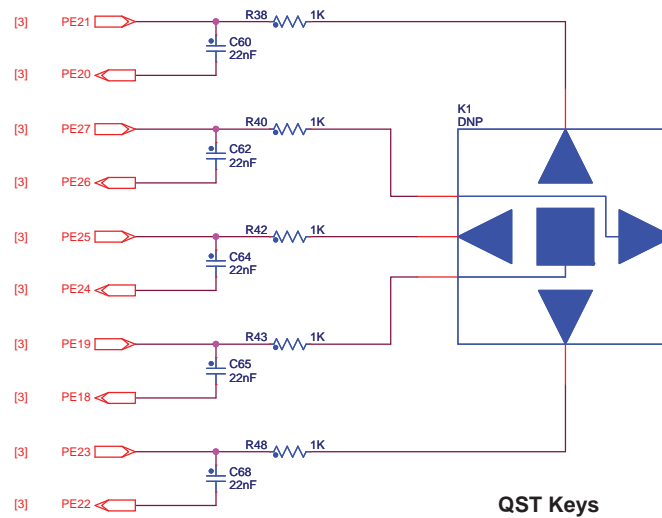
4.3.15 QTouch Elements

QTouch keys consist in a series of sensors formed by the association of a copper area and the capacitive effect of human fingers approaching it.

4.3.15.1 Keys

The SAM3X-EK implements five individual capacitive touch keys (UP, DOWN, RIGHT, LEFT and VALID) using five pairs of PIO.

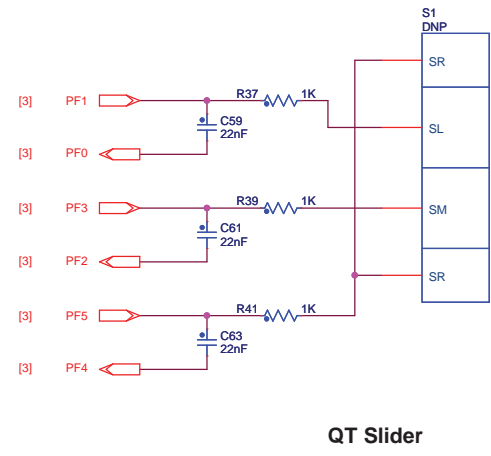
Figure 4-21. QST Keys



4.3.15.2 Slider

A group of channels forms a Slider. A Slider is composed of three channels for a QTouch acquisition method using three pairs of PIO. Such a sensor is used to detect a linear finger displacement on a sensitive area. A typical implementation is volume control.

Figure 4-22. QT_Slider

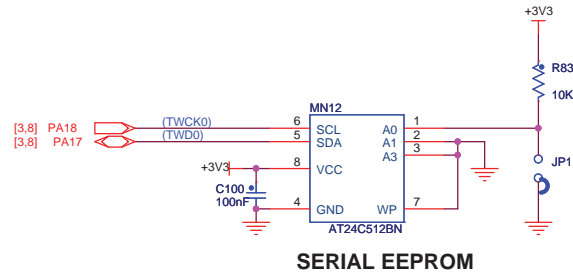


4.3.16 EEPROM

There is one serial EEPROM on the SAM3X-EK, which is connected to TWI interface. Pin1 A0 is pulled up, which sets its TWI address as 51 [0x1010001] by JP11 default open.



Figure 4-23. EEPROM Block



4.3.17 SD Card

The SAM3X-EK has an MMC/MMCPlus high-speed 8-bit multimedia interface. This interface is used as a 4/8-bit interface, connected to an 8-bit SD/MMC card slot with card detection.

Figure 4-24. SD Card Socket

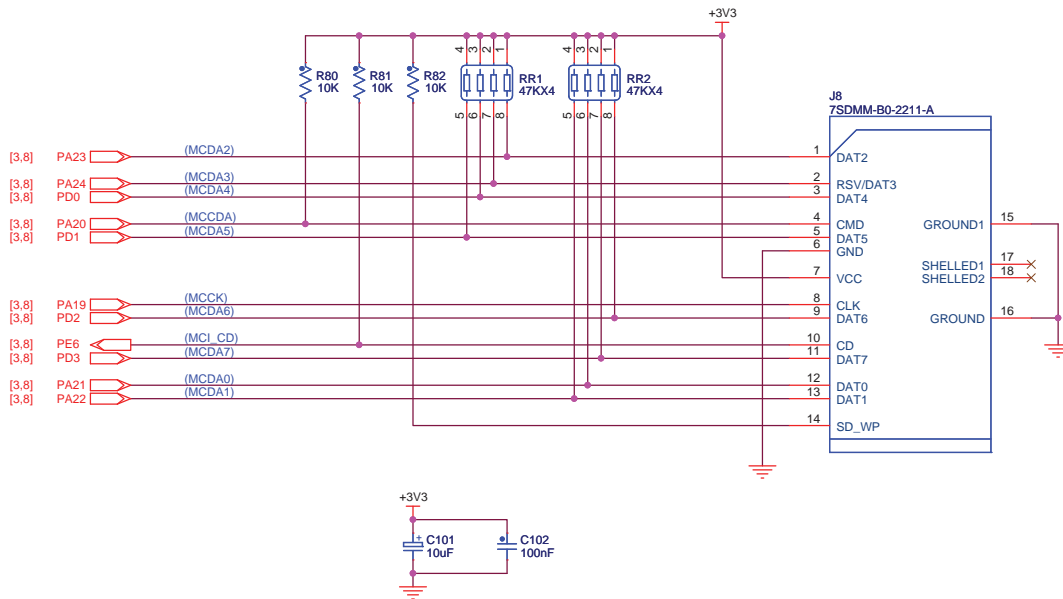


Table 4-3. Pin Card Detection Scheme

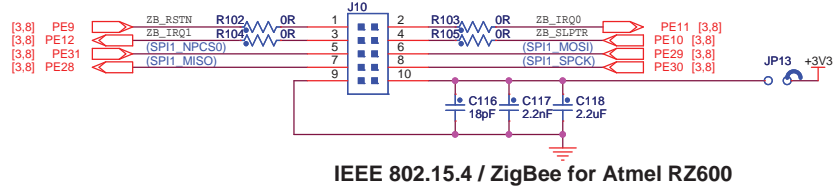
Status	Detection
WITHOUT CARD	SD_WP: OPEN CD: OPEN
SD Card inserted with write protection lock	SD_WP: OPEN CD: GND
SD Card inserted with write protection unlock, or other card inserted	SD_WP: GND CD: GND

4.3.18 IEEE 802.15.4 / ZigBee

SAM3X-EK has a 10-pin male connector for the RZ600 IEEE 802.15.4 / ZigBee module.



Figure 4-25. IEEE 802.15.4 / ZigBee

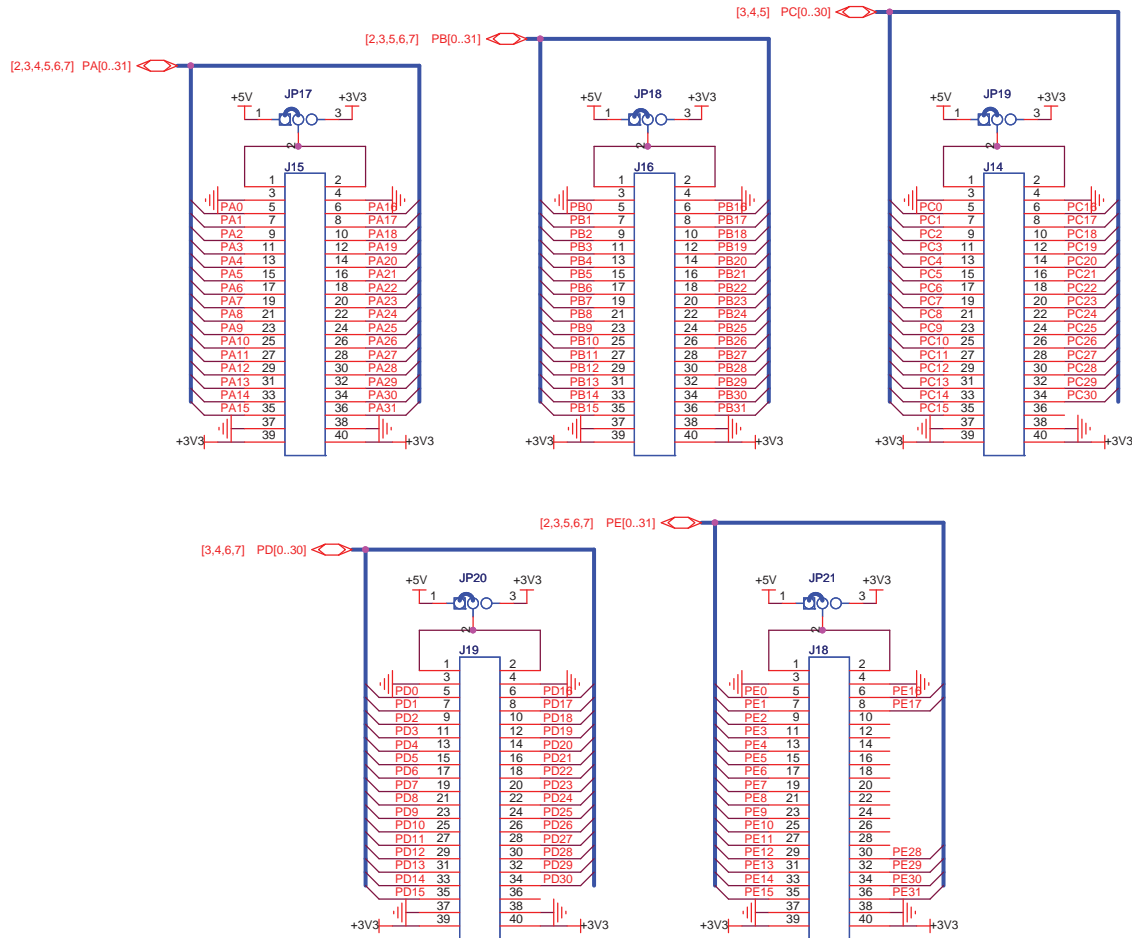


4.3.19 PIO Expansion

The SAM3X8H product features six PIO controllers, PIOA-F, which are multiplexed with the I/O lines of the embedded peripherals. Each PIO Controller controls up to 32 lines (31 for PIOC and PIOD, 6 for PIOF).

Expansion ports J14, J15, J16, J18 and J19 provide PIO lines access for customer defined usage.

Figure 4-26. PIO Expansion Ports



PIO EXPANSION

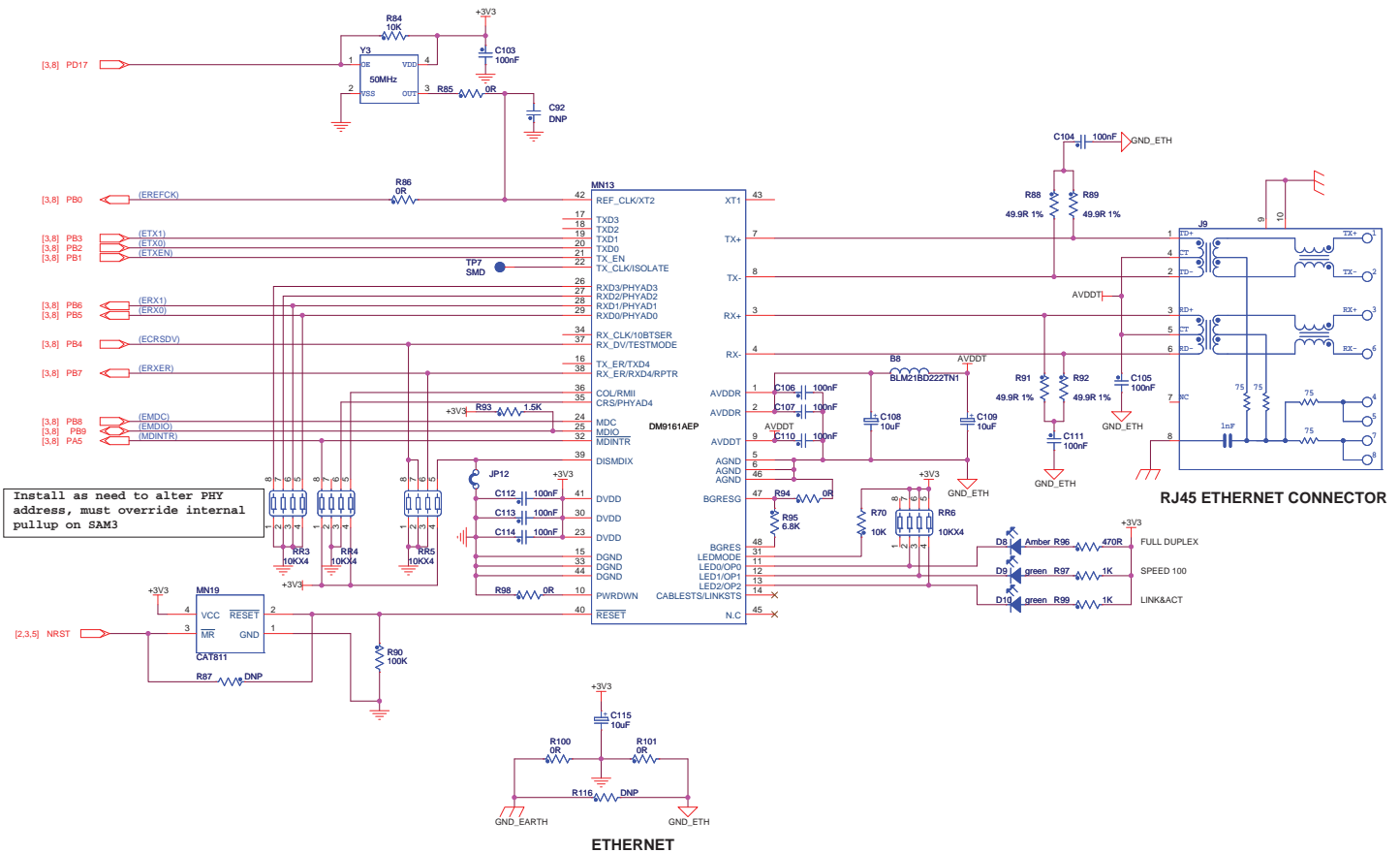
Note: All PIO lines are available on these expansion connectors, except those that are used for the QTouch elements.

4.3.20 Ethernet MAC 10/100 (EMAC)

The EMAC module implements a 10/100 Ethernet MAC compatible with the IEEE 802.3 standard using an address checker, statistics and control registers, receive and transmit blocks, and a DMA interface. The SAM3X-EK is equipped with a Davicom DM9161AEP 10/100 Mbps Fast Ethernet Physical Layer TX/FX Single Chip Transceiver. It contains the entire physical layer functions of 100BASE-TX as defined by IEEE 802.3u, including the Physical Coding Sublayer (PCS), Physical Medium attachment (PMA), Twisted Pair Physical Medium Dependent Sublayer (TP-PMD), 10BASE-TX Encoder/Decoder (ENC/DEC), and Twisted Pair Media Access Unit (TPMAU).

The Ethernet interface provides RMI (Reduced MII), for 100Base-TX or 10Base-TX. The RMI interfaces are capable of both 10Mb/s and 100Mb/s data rates as described in the IEEE 802.3u standard. The Ethernet interface integrates an RJ45 connector with an embedded transformer, and three status LEDs. For guarantee DM9161AEP is reset properly, a reset IC MN19 is integrated too.

Figure 4-27. Ethernet Block



4.3.21 CAN

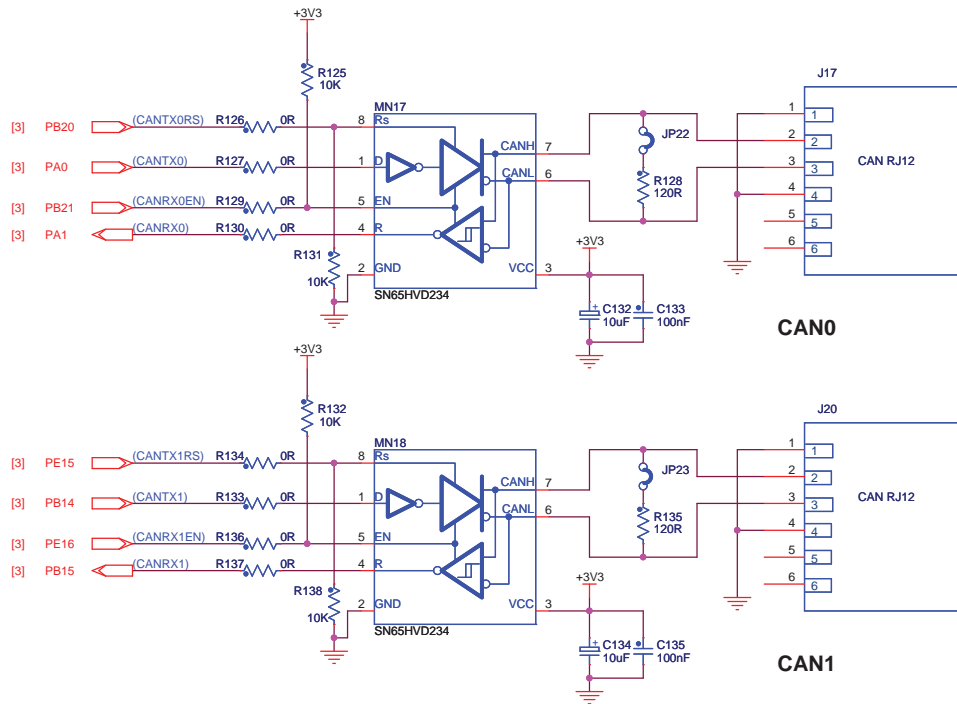
The CAN controller provides all the features required to implement the serial communication protocol CAN defined by Robert Bosch GmbH, the CAN specification as referred to by ISO/11898A (2.0 Part A and 2.0 Part B) for high speeds and ISO/11519-2 for low speeds. The CAN Controller is able to handle all types of frames (Data, Remote, Error and Overload) and achieves a bit rate of 1 Mbit/sec.

The SAM3X8H has two CAN Controllers with eight Mailboxes.



SAM3X-EK connects the CAN0 and CAN1 bus (including CANRX0/1, CANTX0/1, CANRX0/1EN, CANTX0/1RS handshake signals control) to the RJ12 female connector J17 and J20 through the CAN Transceiver MN17 and MN18.

Figure 4-28. CAN



4.4 Configuration

This section describes the PIO usage, the jumpers, the test points and the solder drops of a SAM3U-EK board.



4.4.1 PIO Usage

Table 4-4. PIO Port A Assignment

I/O Line	Peripheral A	Peripheral B	Extra Function	EK Usage	Device
PA0	CANTX0	PWML3		CANTX0	CAN
PA1	CANRX0	PCK0	WKUP0	CANRX0	CAN
PA2	TIOA1	NANDRDY	AD0	NANDRDY	NAND-Flash
PA3	TIOB1	PWMF11	AD1/WKUP1	AD1	ADC INPUT
PA4	TCLK1	NWAIT	AD2		
PA5	TIOA2	PWMF10	WKUP2	MD_INTR	Ethernet
PA6	TIOB2	NCS0	AD3	NCS0	NAND-Flash
PA7	TCLK2	NCS1	WKUP3	NCS1	SDRAM
PA8	URXD	PWMH0	WKUP4	URXD	UART
PA9	UTXD	PWMH3		UTXD	UART
PA10	RXD0	DATRG	WKUP5	RXD0	USART
PA11	TXD0	ADTRG	WKUP6	TXD0	USART
PA12	RXD1	PWML1	WKUP7	USER_LED3	USER_LED
PA13	TXD1	PWMH2		POWER_LED	POWER_LED
PA14	RTS1	TK		TK	Audio codec
PA15	CTS1	TF	WKUP8	TF	Audio codec
PA16	SPCK1	TD	AD7	TD	Audio codec
PA17	TWD0	SPCK0		TWD0	Audio codec
PA18	TWCK0	A20	WKUP9	TWCK0	Audio codec
PA19	MCCK	PWMH1		MCCK	SD/MMC
PA20	MCCDA	PWML2		MCCDA	SD/MMC
PA21	MCDA0	PWML0		MCDA0	SD/MMC
PA22	MCDA1	TCLK3	AD4	MCDA1	SD/MMC
PA23	MCDA2	TCLK4	AD5	MCDA2	SD/MMC
PA24	MCDA3	PCK1	AD6	MCDA3	SD/MMC
PA25	SPI0_MISO	A18		SPI0_MISO	Touch Controller
PA26	SPI0_MOSI	A19		SPI0_MOSI	Touch Controller
PA27	SPI0_SPCK	A20	WKUP10	SPI0_SPCK	Touch Controller
PA28	SPI0_NPCS0	PCK2	WKUP11	SPI0_NPCS0	Touch Controller
PA29	SPI0_NPCS1	NRD		NRD	LCD
PA30	SPI0_NPCS2	PCK1		BUSY_TSC	Touch Controller
PA31	SPI0_NPCS3	PCK2		IRQ_TSC	Touch Controller

Table 4-5. PIO Port B Assignment

I/O Line	Peripheral A	Peripheral B	Extra Function	EK Usage	Device
PB0	ETXCK/EREFCK	TIOA3		ETXCK/EREFCK	Ethernet
PB1	ETXEN	TIOB3		ETXEN	Ethernet
PB2	ETX0	TIOA4		ETX0	Ethernet
PB3	ETX1	TIOB4		ETX1	Ethernet
PB4	ECRSDV/ERXDV	TIOA5		ECRSDV/ERXDV	Ethernet
PB5	ERX0	TIOB5		ERX0	Ethernet
PB6	ERX1	PWML4		ERX1	Ethernet
PB7	ERXER	PWML5		ERXER	Ethernet
PB8	EMDC	PWML6		EMDC	Ethernet
PB9	EMDIO	PWML7		EMDIO	Ethernet
PB10	UOTGVBOF	A18		UOTGVBOF	USB
PB11	UOTGID	A19		UOTGID	USB
PB12	TWD1	PWMH0	AD8	USER_LED2	USER_LED
PB13	TWCK1	PWMH1	AD9	USER_LED1	USER_LED
PB14	CANTX1	PWMH2		CANTX1	CAN
PB15	CANRX1	PWMH3	DAC0/WKUP12	CANRX1	CAN
PB16	TCLK5	PWML0	DAC1		
PB17	RF	PWML1	AD10	RF	Audio codec
PB18	RD	PWML2	AD11	RD	Audio codec
PB19	RK	PWML3	AD12	RK	Audio codec
PB20	TXD2	SPI0_NPCS1	AD13	CANTX0RS	CAN
PB21	RXD2	SPI0_NPCS2	AD14/WKUP13	CANRX0EN	CAN
PB22	RTS2	PCK0		PCK0	Audio codec
PB23	CTS2	SPI0_NPCS3	WKUP14	BP4_RIGHT	USER KEY
PB24	SCK2	NCS2		NCS2	LCD
PB25	RTS0	TIOA0		RTS0	USART
PB26	CTS0	TCLK0	WKUP15	CTS0	USART
PB27	NCS3	TIOB0		BL_EN	LCD
PB28	TCK/SWCLK			TCK	JTAG/ICE
PB29	TDI			TDI	JTAG/ICE
PB30	TDO/TRACESWO			TDO	JTAG/ICE
PB31	TMS/SWDIO			TMS	JTAG/ICE

Table 4-6. PIO Port C Assignment

I/O Line	Peripheral A	Peripheral B	Extra Function	EK Usage	Device
PC0			ERASE	ERASE	SAM3X8H
PC1					
PC2	D0	PWML0		D0	SDRAM, NAND-Flash, LCD
PC3	D1	PWMH0		D1	SDRAM, NAND-Flash, LCD
PC4	D2	PWML1		D2	SDRAM, NAND-Flash, LCD
PC5	D3	PWMH1		D3	SDRAM, NAND-Flash, LCD
PC6	D4	PWML2		D4	SDRAM, NAND-Flash, LCD
PC7	D5	PWMH2		D5	SDRAM, NAND-Flash, LCD
PC8	D6	PWML3		D6	SDRAM, NAND-Flash, LCD
PC9	D7	PWMH3		D7	SDRAM, NAND-Flash, LCD
PC10	D8	ECRS		D8	SDRAM, NAND-Flash, LCD
PC11	D9	ERX2		D9	SDRAM, NAND-Flash, LCD
PC12	D10	ERX3		D10	SDRAM, NAND-Flash, LCD
PC13	D11	ECOL		D11	SDRAM, NAND-Flash, LCD
PC14	D12	ERXCK		D12	SDRAM, NAND-Flash, LCD
PC15	D13	ETX2		D13	SDRAM, NAND-Flash, LCD
PC16	D14	ETX3		D14	SDRAM, NAND-Flash, LCD
PC17	D15	ETXER		D15	SDRAM, NAND-Flash, LCD
PC18	NWR0/NWE	PWMH6		NWE	LCD
PC19	NANDOE	PWMH5		NANDOE	NAND-Flash
PC20	NANDWE	PWMH4		NANDWE	NAND-Flash
PC21	A0/NBS0	PWML4		NBS0	SDRAM
PC22	A1	PWML5		A1	LCD
PC23	A2	PWML6		A2	SDRAM
PC24	A3	PWML7		A3	SDRAM
PC25	A4	TIOA6		A4	SDRAM
PC26	A5	TIOB6		A5	SDRAM
PC27	A6	TCLK6		A6	SDRAM
PC28	A7	TIOA7		A7	SDRAM
PC29	A8	TIOB7		A8	SDRAM
PC30	A9	TCLK7		A9	SDRAM

Table 4-7. PIO Port D Assignment

I/O Line	Peripheral A	Peripheral B	Extra Function	EK Usage	Device
PD0	A10	MCDA4		MCDA4	SD/MMC
PD1	A11	MCDA5		MCDA5	SD/MMC
PD2	A12	MCDA6		MCDA6	SD/MMC
PD3	A13	MCDA7		MCDA7	SD/MMC
PD4	A14	TXD3		A14	SDRAM
PD5	A15	RXD3			
PD6	A16/BA0	PWMFI2		BA0	SDRAM
PD7	A17/BA1	TIOA8		BA1	SDRAM
PD8	A21/NANDALE	TIOB8		NANDALE	NAND-Flash
PD9	A22/NANDCLE	TCLK8		NANDCLE	NAND-Flash
PD10	NWR1/NBS1			NBS1	SDRAM
PD11	SDA10			SDA10	SDRAM
PD12	SDCS			SDCS	SDRAM
PD13	SDCKE			SDCKE	SDRAM
PD14	SDWE			SDWE	SDRAM
PD15	RAS			RAS	SDRAM
PD16	CAS			CAS	SDRAM
PD17	A5			OSC_OE	Ethernet
PD18	A6				
PD19	A7				
PD20	A8				
PD21	A9				
PD22	A10			A10	SDRAM
PD23	A11			A11	SDRAM
PD24	A12				
PD25	A13			A13	SDRAM
PD26	A14				
PD27	A15				
PD28	A16/BA0				
PD29	A17/BA1				
PD30	A18				

Table 4-8. PIO Port E Assignment

I/O Line	Peripheral A	Peripheral B	Extra Function	EK Usage	Device
PE0	A19				
PE1	A20				
PE2	A21/NANDALE				
PE3	A22/NANDCLE				
PE4	A23				
PE5	NCS4			USB_FAULT	USB
PE6	NCS5			MCI_CD	SD/MMC
PE7				BP5_LEFT	USER KEY
PE8					
PE9	TIOA3			ZB_RSTN	ZigBee
PE10	TIOB3			ZB_SLPTR	ZigBee
PE11	TIOA4			ZB_IRQ0	ZigBee
PE12	TIOB4			ZB_IRQ1	ZigBee
PE13	TIOA5				
PE14	TIOB5			COM0_EN	RS232
PE15	PWMH0			CANTX1RS	CAN
PE16	PWMH1	SCK3		CANRX1EN	CAN
PE17	PWML2				
PE18	PWML0	NCS6		QTVALID_SNS	QTouch Keys
PE19	PWML4			QTVALID_SNSK	QTouch Keys
PE20	PWMH4	MCCDB		QTUP_SNS	QTouch Keys
PE21	PWML5			QTUP_SNSK	QTouch Keys
PE22	PWMH5	MCDB0		QTDWN_SNS	QTouch Keys
PE23	PWML6			QTDWN_SNSK	QTouch Keys
PE24	PWMH6	MCDB1		QTLEFT_SNS	QTouch Keys
PE25	PWML7			QTLEFT_SNSK	QTouch Keys
PE26	PWMH7	MCDB2		QTRIGHT_SNS	QTouch Keys
PE27	NCS7	MCDB3		QTRIGHT_SNSK	QTouch Keys
PE28	SPI1_MISO			SPI1_MISO	ZigBee
PE29	SPI1_MOSI			SPI1_MOSI	ZigBee
PE30	SPI1_SPCK			SPI1_SPCK	ZigBee
PE31	SPI1_NPCS0			SPI1_NPCS0	ZigBee

Table 4-9. PIO Port F Assignment

I/O Line	Peripheral A	Peripheral B	Extra Function	EK Usage	Device
PF0	SPI1_NPCS1			QTSLIDER_SL_SNS	QTouch Slider
PF1	SPI1_NPCS2			QTSLIDER_SL_SNSK	QTouch Slider
PF2	SPI1_NPCS3			QTSLIDER_SM_SNS	QTouch Slider
PF3	PWMH3			QTSLIDER_SM_SNSK	QTouch Slider
PF4	CTS3			QTSLIDER_SR_SNS	QTouch Slider
PF5	RTS3			QTSLIDER_SR_SNSK	QTouch Slider

4.4.2 Jumpers

The SAM3X-EK board jumpers are essentially used for two main purposes: functional selection or current measurement. Details are given below.

Table 4-10. Jumpers Setting

Designation	Label	Default Setting	Feature
JP1(1-2)	VDDIO	CLOSE	Access for current measurement on VDDIO
JP1(3-4)	VDDCORE	CLOSE	Access for current measurement on VDDCORE
JP1(5-6)	VDDPLL	CLOSE	Access for current measurement on VDDPLL
JP1(7-8)	VDDUTMI	CLOSE	Access for current measurement on VDDUTMI
JP1(9-10)	VDDIN	CLOSE	Access for current measurement on VDDIN
JP1(11-12)	VDDANA	CLOSE	Access for current measurement on VDDANA
JP2	VDDBU	CLOSE	Access for current measurement on VDDBU
JP3	FORCE POWER ON	CLOSE	Close Force +3V3 LDO output valid
JP4	ADC INPUT	CLOSE	ADC input potentiometer
JP6	ERASE	OPEN	Close to reinitialize the Flash contents and some of its NVM bits
JP7	ADVREF	1-2	Analog reference voltage selection between 3.3V (close 1-2) and 3.0V (close 2-3)
JP8	NCS0	CLOSE	NCS0 enable NAND Flash chip select
JP9	SDCS	CLOSE	SDCS enable SDRAM Flash chip select
JP10	NCS2	CLOSE	NCS2 chip select LCD
JP11	ADDRESS SELECT	OPEN	EEPROM TWI address select (OPEN:51 CLOSE:50)
JP12	DISMDIX	CLOSE	Enable HP Auto-MDIX mode
JP13	ZIGBEE	CLOSE	Power supply connection/disconnection for the ZigBEE module May also be used as a current measurement point



Table 4-10. Jumpers Setting

Designation	Label	Default Setting	Feature
JP14-JP16	RS485	CLOSE	RS485 bus termination resistors selection
JP17-JP21	PIO expansion connector voltage supply	2-3	Set to 3.3V (position 1-2 sets to 5V)
JP22-JP23	CAN	CLOSE	CAN bus termination resistors selection

4.4.3 Test Points

Some test points have been placed on the SAM3X-EK board for the verification of important signals.

Table 4-11. Test Points

Designation	Part	Description
TP1	Ring Hook	GND
TP2	Ring Hook	GND
TP3	Ring Hook	GND
TP4	Ring Hook	GND
TP5	Pad	Aux ADC input IN3 for touch screen control
TP6	Pad	Aux ADC input IN4 for touch screen control
TP7	Pad	Ethernet TX CLK

4.4.4 Assigned PIO Lines, Disconnection Possibility

As pointed out previously in the interface description, 0 Ohm resistors have been inserted on the path of the receiver PIO lines of the SAM3X-EK. These are the PIO lines connected to an external driver on the board. The 0 Ohm resistors allow disconnecting each of these for custom usage (through PIO expansion connectors for example). This feature gives the user an added level of versatility for prototyping a system of his own. See the table below.

Table 4-12. Disconnecting Possibility

Designation	Default Assignment	PIO
R24	0R	NRST
R32	0R	PA2, RDY/BSY on NAND Flash
R35	0R	PA3
R51	0R	PA28
R52	0R	PA30
R53	0R	PA31
R44-47	0R	LCD parallel backlight LED anode
R60	0R	PB27
R71	0R	PA14
R72	0R	PB19
R73	0R	PB18
R74	0R	PB17



Table 4-12. Disconnecting Possibility

Designation	Default Assignment	PIO
R86	0R	PB0
R102	0R	PE9
R103	0R	PE11
R104	0R	PE12
R105	0R	PE10
R109	0R	PA10, RS485
R110	0R	PB26, RS485
R113	0R	PB25, RS485
R114	0R	PA11, RS485
R119	0R	PE14
R120	0R	PA11, RS232
R121	0R	PA10, RS232
R122	0R	PB25, RS232
R123	0R	PB26, RS232
R126	0R	PB20
R127	0R	PA0
R129	0R	PB21
R130	0R	PA1
R133	0R	PB14
R134	0R	PE15
R136	0R	PE16
R137	0R	PB15

Table 4-13. Default Not Populated Parts

Designation	Default Assignment
R15	Optional termination for ADC input
R87	Optional RC filter for DM9161AEP reset
C92	Optional filter for 50MHz Oscillator output
D7	Optional ESD protection for LCD touch panel
K1	Virtual component for QTouch keys set - implemented as copper areas
S1	Virtual component for QTouch slider set - implemented as copper areas
R34	Optional write protection NAND Flash
R139,R140	Optional JTAGSEL and TST enable
R108,R118	Optional termination for RS485



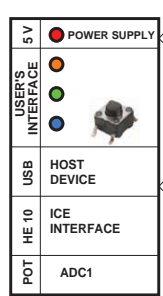
Section 5

Schematics

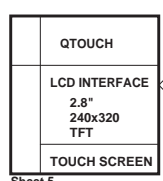
5.1 Schematics

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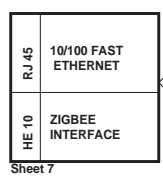
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- POWER SUPPLY & USB & JTAG
- ATSAM3X_LFBGA217
- EBI_MEMORY
- DISPLAY & QTouch
- Audio & HSMCI & TWI
- ETHERNET & ZIGBEE
- SERIAL & USER INTERFACES



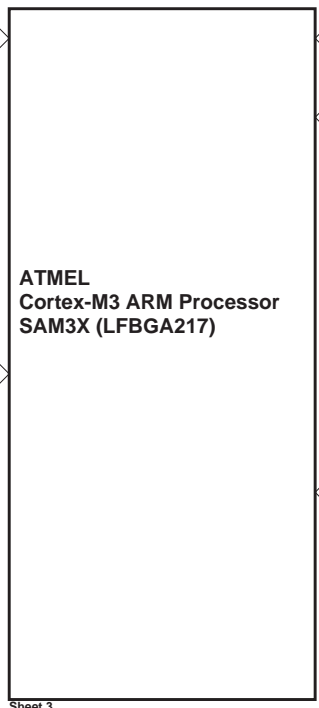
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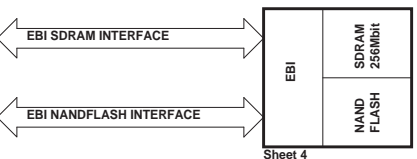
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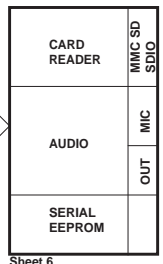
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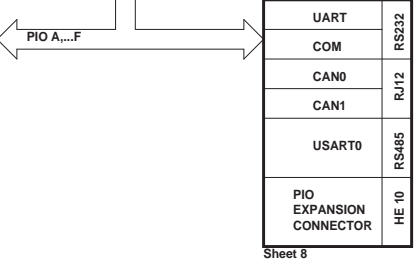
Sheet 3



Sheet 4



Sheet 6

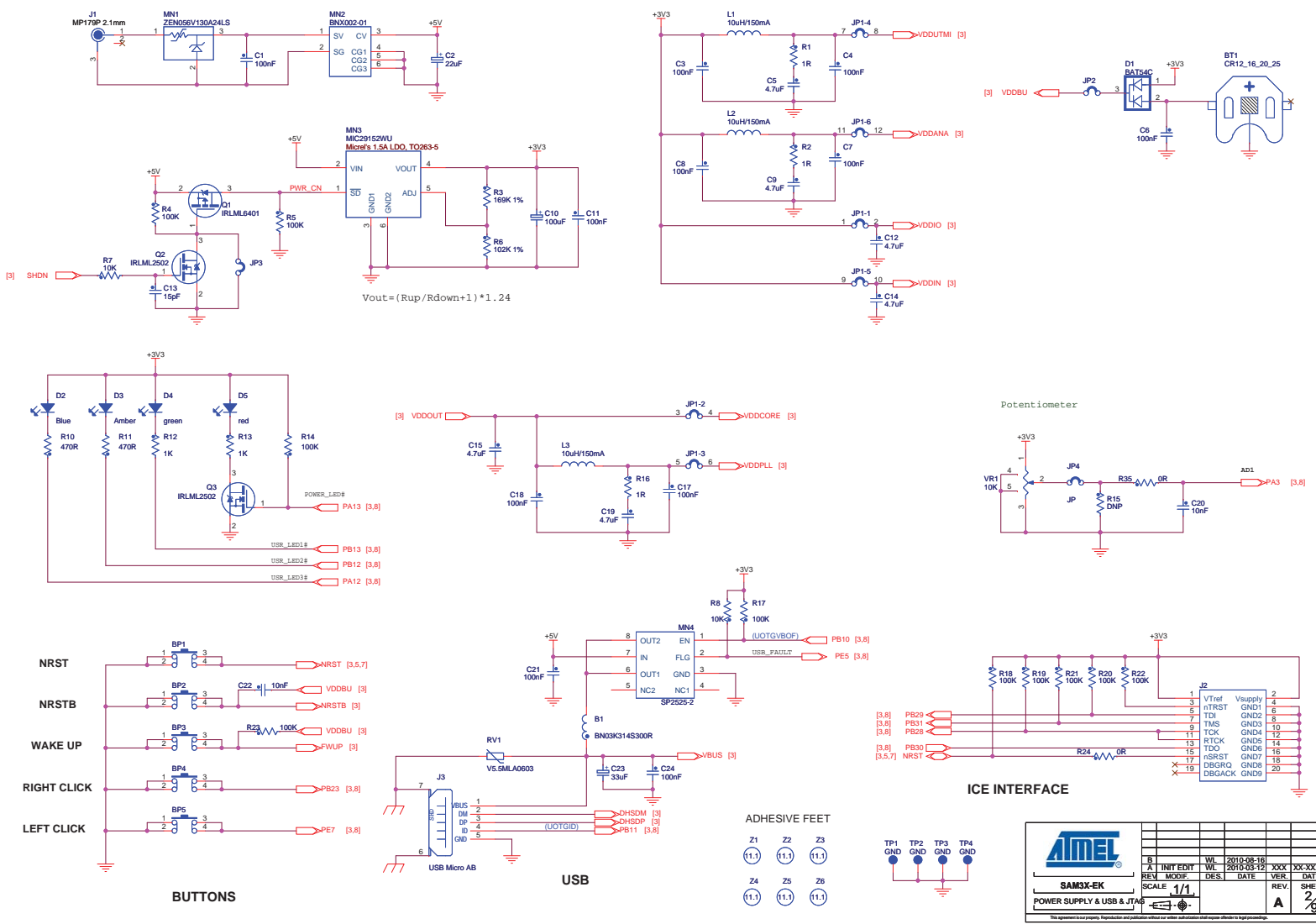


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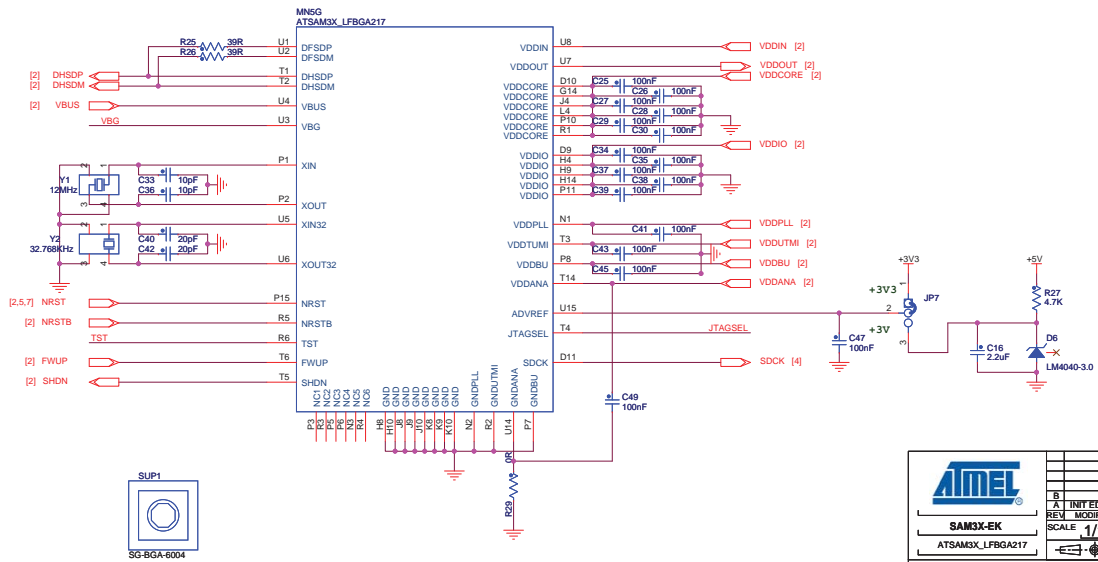
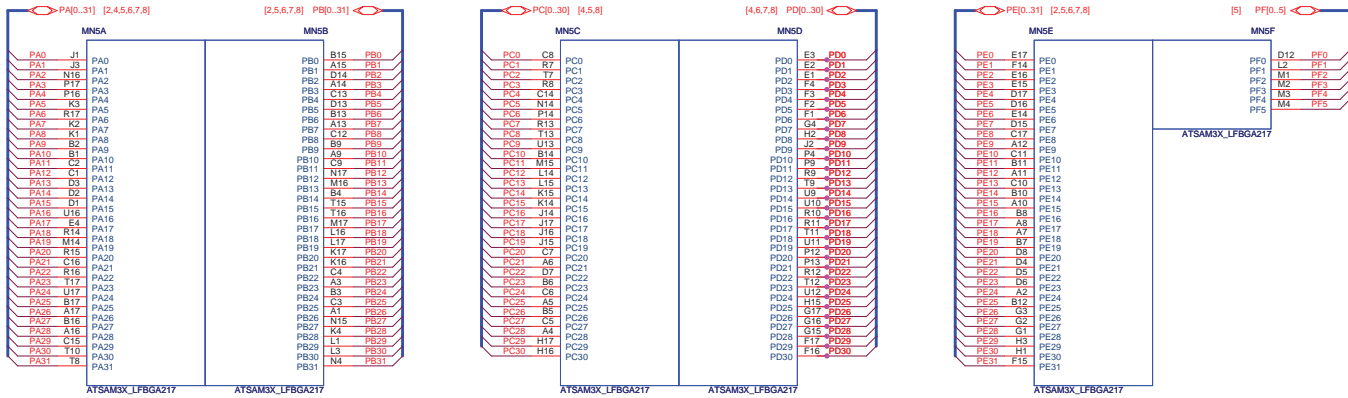
PIO MUXING																						
PAZ	CANRX0	PAL1	TW00	FR2	ST20	USAGE	PR19	BK	USAGE	PC4	D2	PC21	MBE5	PDV	BA1	USAGE	PD24	USAGE	PE10	USAGE	PE21	USAGE
PAL1	CANRX0	PAL9	TW00	FR3	ST21		PR20	CANRX0R	PC5	D3	PC22	AL	PD8	MBDALE	PD25	AL3	PE11	SB_IRQ0	PE28	SP11_RIS0		
PAL2	MBDRDY0	PAL8	MC0E	FR4	ST22		PR21	CANRX0R	PC6	DA	PC23	AL	PD9	MBDALE	PD26		PE12	SB_IRQ1	PE29	SP11_MOSI		
PAL3	AD1	PAL7	MC0DA	FR5	ST23		PR22	PC20	PC7	DB	PC24	AL3	PD10	MBE1	PD27		PE13	SB_IRQ2	PE30	SP11_SPCK		
PAL4	MD1MTR	PAL6	MC0DA	FR6	ST24		PR23	BP4_RIGHT	PC8	DE	PC25	AL4	PD11	SDALO	PD28		PE14	CMO_EN	PE31	SP11_BPCS0		
PAL5	MD1MTR	PAL5	MC0DA	FR7	ST25		PR24	MC02	PC9	DF	PC26	AL5	PD12	SDCKE	PD29		PE15	CANRX1EN	PE32	OTFBLDR_IL_SNS0		
PAL6	MC02	PAL4	MC0DA	FR8	ST26		PR25	RT00	PC10	DB	PC27	AL6	PD13	SDCKE	PD30		PE16	CANRX1EN	PE33	OTFBLDR_IL_SNS0		
PAL7	MC01	PAL3	MC0DA	FR9	ST27		PR26	CT00	PC11	DF	PC28	AL7	PD14	SDWR	PD31		PE17	OTFBLDR_IL_SNS0	PE34	OTFBLDR_IL_SNS0		
PAL8	TXD0	PAL2	SP10_RLSD0	FR10	ST28		PR27	ML_DR	PC12	D0	PC29	AL8	PD15	SAB	PD32		PE18	OTFVALD_SNS	PE35	OTFBLDR_IL_SNS0		
PAL9	UTXD0	PAL1	SP10_WD01	FR11	ST29		PR28	TC0	PC13	D11	PC30	AL9	PD16	CAS	PD33		PE19	OTFVALD_SNS	PE36	OTFBLDR_IL_SNS0		
PAL10	TXD0	PAL0	SP10_SPCK	FR12	ST30		PR29	USER_LED3	PC14	D12	PC31	MC0A4	PD17	ODR_OE	PD34		PE20	OTFVALD_SNS	PE37	OTFBLDR_IL_SNS0		
PAL11	TXD0	PAL0	SP10_BPCS0	FR13	ST31		PR30	USER_LED1	PC15	D13	PC32	MC0A5	PD18		PD35		PE21	OTFVALD_SNS	PE38	OTFBLDR_IL_SNS0		
PAL12	USER_LED3	PAL0	NRD	FR14	ST32		PR31	CANRX1	PC16	D14	PC33	MC0A6	PD19		PD36		PE22	OTFVALD_SNS	PE39	OTFBLDR_IL_SNS0		
PAL13	POWER_LED	PAL0	IR0V_TSC	FR15	ST33		PR32	CANRX1	PC17	D15	PC34	MC0A7	PD20		PD37		PE23	OTFVALD_SNS	PE40	OTFBLDR_IL_SNS0		
PAL14	TK	PAL0	IR0V_TSC	FR16	ST34		PR33	NR0	PC18	NR0	PC35	AL4	PD21		PD38		PE24	OTFVALD_SNS	PE41	OTFBLDR_IL_SNS0		
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PAL16	TD	PAL0	BTXEN	FR18	ST36		PR35	RD	PC20	D1	PC37	BAR00E	PD23	AL1	PD40		PE26	SB_RSTN	PE43	OTFBLDR_IL_SNS0		

NOTE
"DNP" means the component is not populated by default

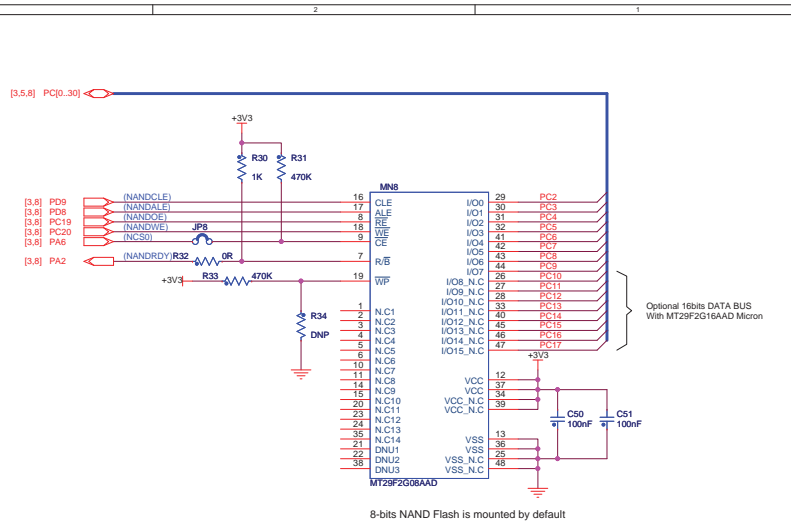
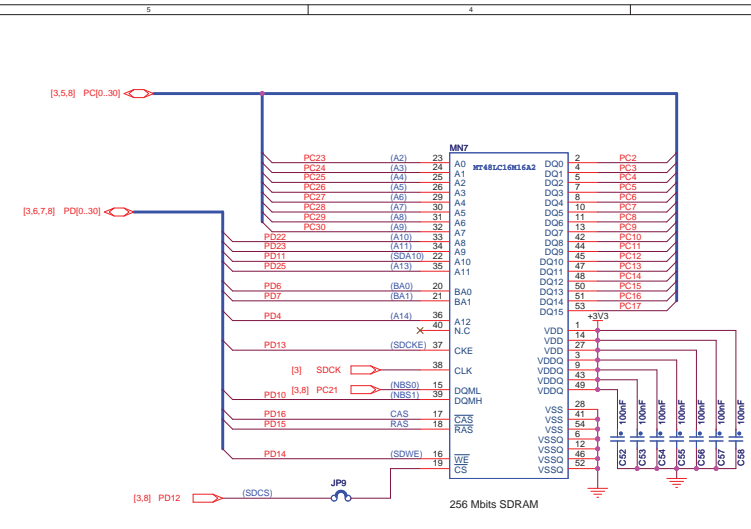
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		DATE	DATE
		REV.	1
		SHEET	1/8



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SAM3X-EK		POWER SUPPLY & USB & JTAG	
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MODIF	DES	DATE	XXX-XXX-XX
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SHEET 2		9	

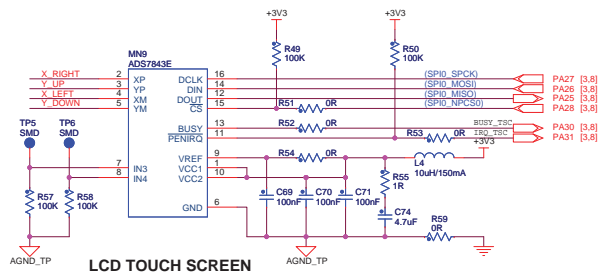
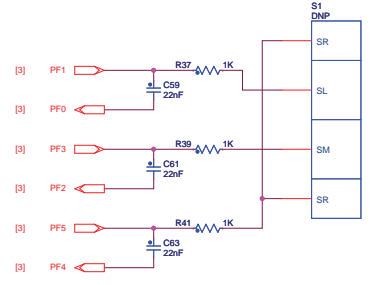
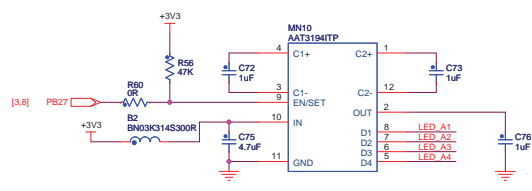
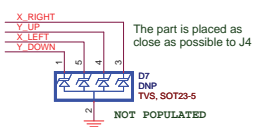
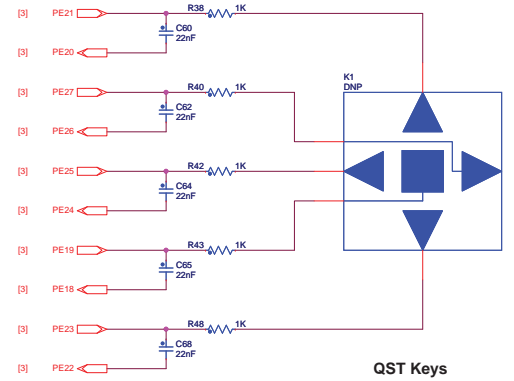
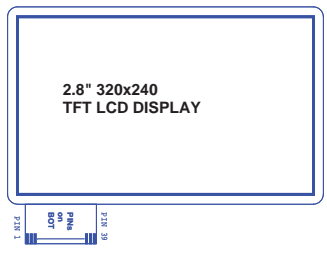
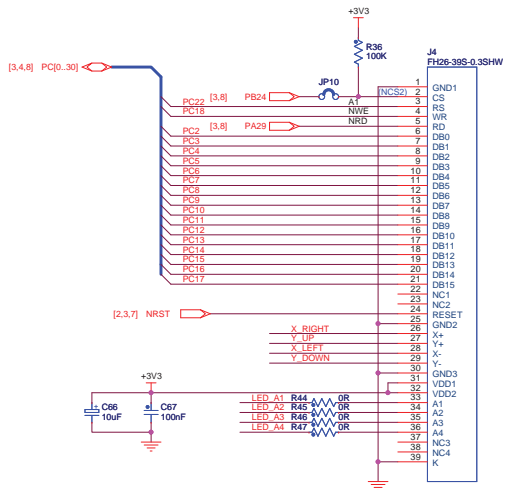


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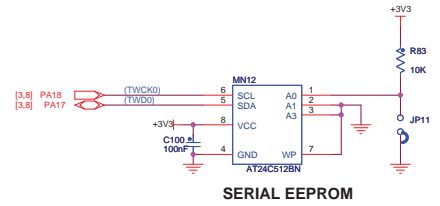
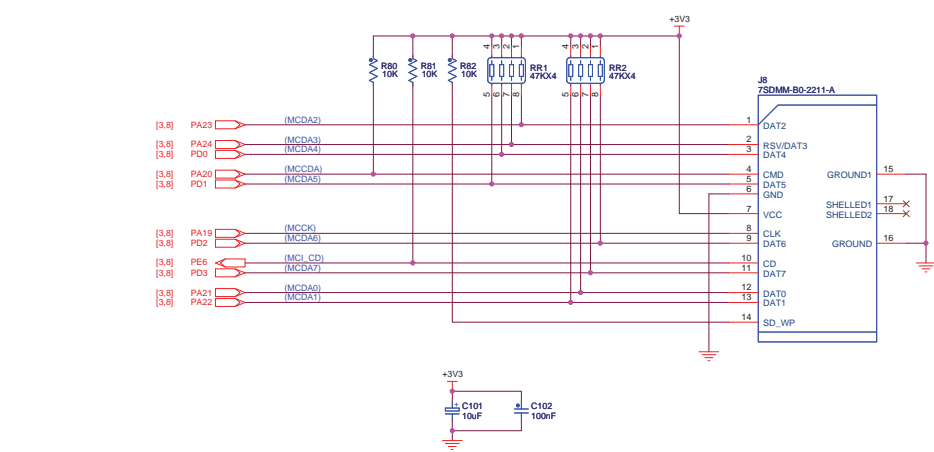
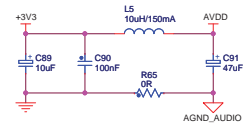
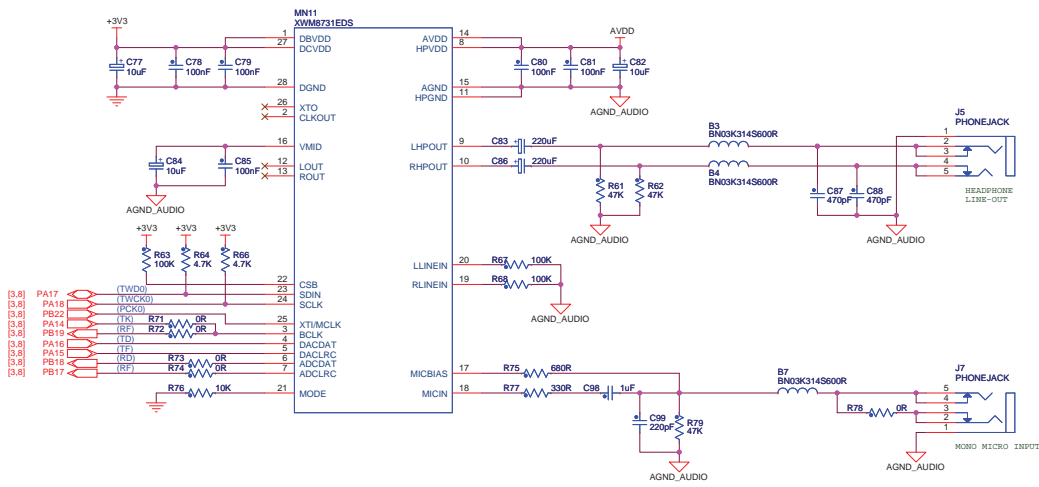


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SAM3X-EK EBI MEMORY		SCALE		1/1			REV.		A
								4/8	

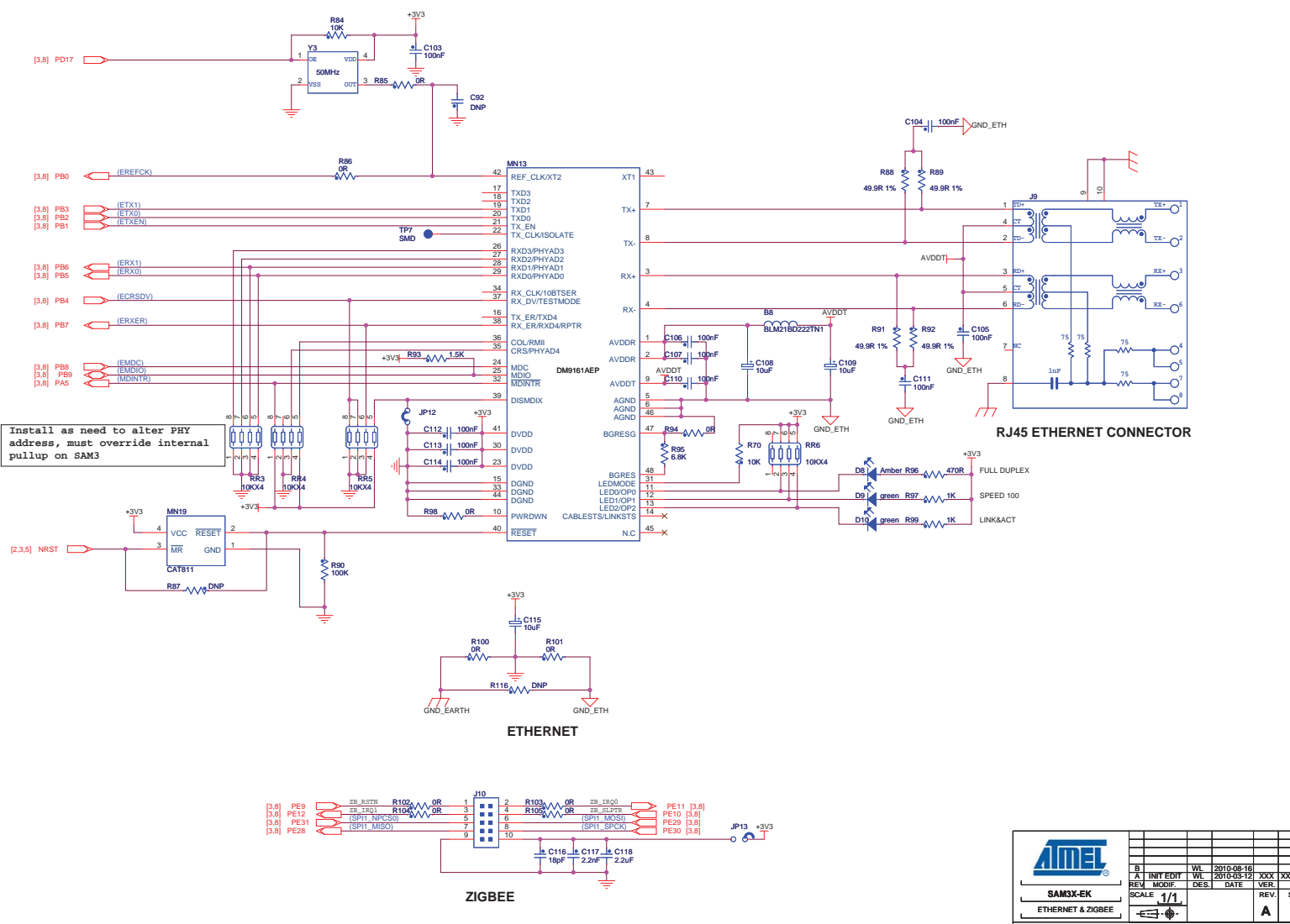
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DISPLAY & QTtouch		SCALE 1/1		REV. DATE		SHEET 5/8	
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B	INIT	WL	2010-08-16	XXX	XX-XXX-XX		
A	MODIF.	DES.	DATE	VER.	DATE		



ATMEL							
SAM3X-EK		SCALE 1/1		REV. VER.		SHEET 6/8	
Audio & HSMCI & TWI							
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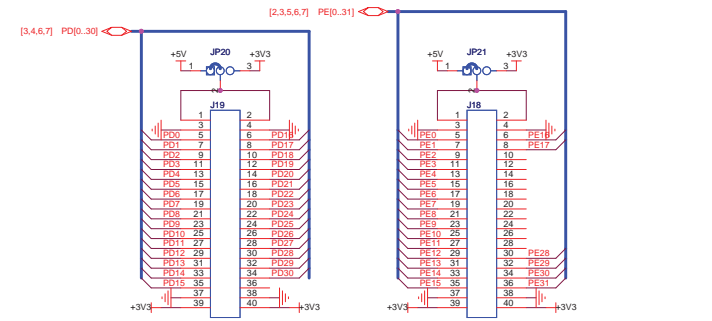
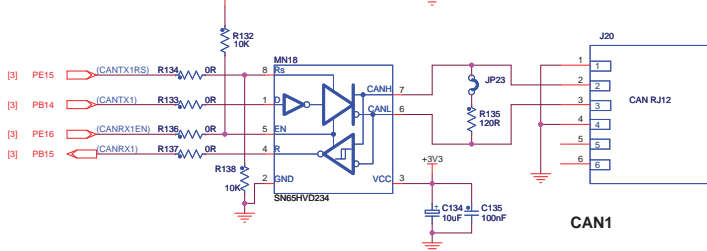
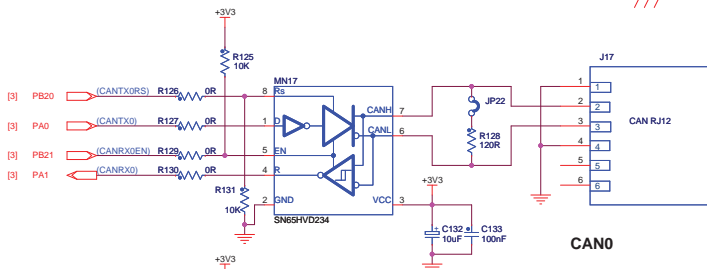
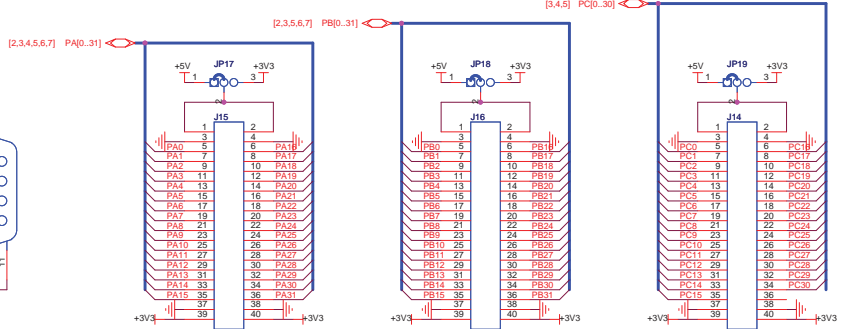
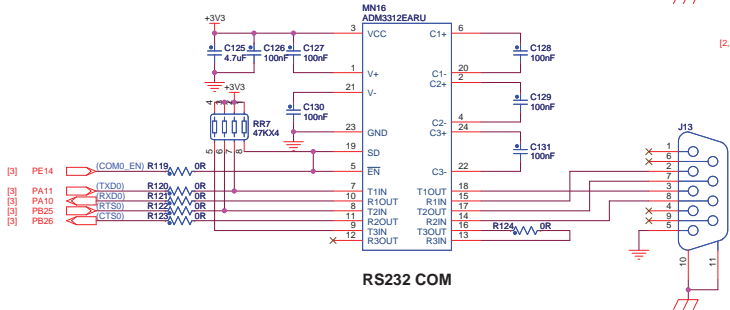
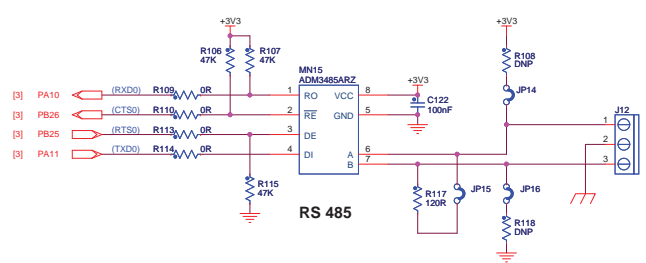
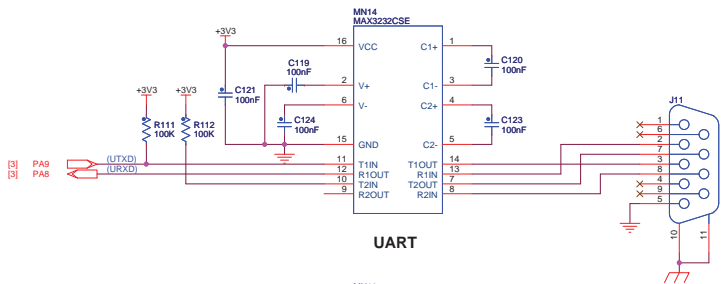
Install as need to alter PHY address, must override internal pullup on SAM3

RJ45 ETHERNET CONNECTOR

ETHERNET

ZIGBEE

ATMEL							
SAM3X-EK							
ETHERNET & ZIGBEE		SCALE 1/1		REV. VER.		SHEET 7/8	
REV. A		DATE 2010-08-16		DES. DATE		XXX-XXX-XX	
INIT EDIT		WL		DATE		DATE	
MODIF.		DES.		REV.		DATE	



PIO EXPANSION

ATMEL		SCALE 1/1		REV. VER. DATE	
SAM3X-EK		SERIAL & USER INTERFACES		REV. 8 / SHEET 8	
B	INIT	WL	2010-08-16	XXX	XX-XXX-XX
A	MODIF.	DES.	DATE	VER.	DATE



Section 6

Troubleshooting

6.1 Self-Test

A test package software is available to implement a functional test for each section of the board. Refer to the SAM3X-EK page on www.atmel.com.

6.2 Board Recovery

The SAM3X-EK is delivered with an on-board recovery procedure allowing to reprogram the board as it was when shipped. This procedure is accessible from the Flash disk mounted on a PC when the board is connected to this PC through the USB as described in [Section 3](#).



Section 7

Revision History

7.1 Revision History

Table 7-1.

Document	Comments	Change Request Ref.
11156A	First issue.	



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