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ARM-based Embedded MPUs

SAMA5D3x-EK User Guide

USER GUIDE

Introduction

This user guide introduces the evaluation kits for the Atmel® SAMA5D3 series embedded MPUs listed below:

- SAMA5D31
- SAMA5D33
- SAMA5D34
- SAMA5D35
- SAMA5D36

It pertains to the following evaluation kit references:

- SAMA5D31-EK
- SAMA5D33-EK
- SAMA5D34-EK
- SAMA5D35-EK
- SAMA5D36-EK

Contents

Important: Unpack and assemble the kit carefully, following the assembly guide provided in the box.

- Boards
    - One SAMA5D3 main board (MB)
    - One of the five available CPU module (CM) boards
        - SAMA5D31-CM
        - SAMA5D33-CM
        - SAMA5D34-CM
        - SAMA5D35-CM
        - SAMA5D36-CM
    - One optional Display Module (DM) board (5"_WVGA_R-DM), available for all SAMA5D3x evaluation kits that feature an LCD interface: SAMA5D31, SAMA5D33, SAMA5D34, SAMA5D36
- Power supply
    - One universal input AC/DC power supply with US, Europe and UK plug adapters
    - One 3V lithium battery type CR1225
- Cables
    - One micro A/B-type USB cable
    - One RJ45 crossed cable
- A welcome letter

Related Items

- Atmel SAMA5D3 Series Datasheet

Table of Contents

1. Evaluation Kit Specifications

Table 1-1. Evaluation Kit Specifications

Characteristic	Specifications
Clock speed	Up to 536 MHz PCK, up to 166 MHz MCK
Ports	10/100/1000 Ethernet, USB, RS232, JTAG, CAN, Audio, HDMI, SD card
Board supply voltage	5V DC from connector
Dimensions: MB (Main Board) CM (Computer Module) Board DM (Display Module) Board	 165 * 135 * 20 mm 67.60 * (40 to 47) * 5 mm 135 * 80 * 6 mm
RoHS status	Compliant
CE and FCC Part 15 status	Compliant
Kit Identification	SAMA5D31-EK SAMA5D33-EK SAMA5D34-EK SAMA5D35-EK SAMA5D36-EK

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 subjected 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 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 LCD should light up and display a welcome page. Click or touch icons displayed on the screen and view the demo (the red ones need to be replaced by demo software).

2.2   Sample Code and Technical Support

After booting up the board, you can run sample code or your own application on the development kit. You can download sample code and get technical support from the Atmel web site.

Linux software and demos can be found on the web site Linux4SAM.

3. Evaluation Kit Hardware

3.1 Introduction

The Atmel SAMA5D3 series evaluation kit is a fully-featured evaluation platform for Atmel SAMA5D3 series microcontrollers. The evaluation kit allows users to extensively evaluate, prototype and create application-specific designs.

The Atmel SAMA5D3 series evaluation kit is a platform architecture based on a main board, a computer module equipped with a SAMA5D3 series processor and an optional display module, providing maximum flexibility for kit users.

The SAMA5D3 series evaluation kit consists of three boards:

● The computer module (CM) board, is a single-board computer that integrates all the core components and is mounted onto an application-specific main board (MB). The computer module has specified pinouts based on the SODIMM200 connector. It provides the functional requirements for an embedded application. These functions include, but are not limited to, graphics, audio, mass storage, network and multiple serial and USB ports. A single SODIMM200 connector provides the main board interface to carry all the I/O signals to and from the computer module.

● The main board (MB) 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 board (DM) integrates LCD, touchscreen and Qtouch® technology

Table 3-1. Evaluation Kit Features

Feature	SAMA5D31	SAMA5D33	SAMA5D34	SAMA5D35	SAMA5D36
CAN0			X	X	X
CAN1			X	X	X
GMAC		X	X	X	X
EMAC	X			X	X
HSMCI1	X	X	X	X	X
HSMCI2		X	X	X	X
LCDC	X	X	X		X
UART0	X			X	X
UART1	X			X	X
ISI	X	X	X	X	X
SHA	X	X	X	X	X
AES	X	X	X	X	X
TDES	X	X	X	X	X
TC1	X	X	X	X	X

# 4.	CPU Module (CM) Board

## 4.1	Overview

The CPU module (CM) board is the heart of the SAMA5D3x-EK. It connects to the main board through a SODIMM200 interface and integrates the SAMA5D3 series processor and external memories. The CM board serves as a minimal CPU sub-system. All five SAMA5D31, SAMA5D33, SAMA5D34, SAMA5D35 and SAMA5D36 processors share the same CM board circuitry with minor configuration settings.

The CM board connects to a carrier board containing its connectors, power supply and any expansion I/O through a standard gold-plated SODIMM 200-pin connection.

Note:	There are five CM boards from three different manufacturers. The five processors are implemented as shown in Table 4-1.

**Table 4-1.	CM Board Implementation**

Manufacturer and Module Kind	SAMA5D31-CM	SAMA5D33-CM	SAMA5D34-CM	SAMA5D35-CM	SAMA5D36-CM
Embest/Flextronics	X		X		X
Ronetix	X	X	X	X	

The five CM boards share the same circuitry design with different designator information and PCB layouts. The circuitry reference in this guide, for common design parts, refers to schematics from SAMA5D3 series-CM (mfg2). All the other schematics are provided in the Section 4.4 "Embest/Flextronics Schematics" and Section 4.5 "Ronetix Schematics".

**Figure 4-1.** CPU Module Board from Embest/Flextronics

Figure 4-2. CPU Module Board from Ronetix
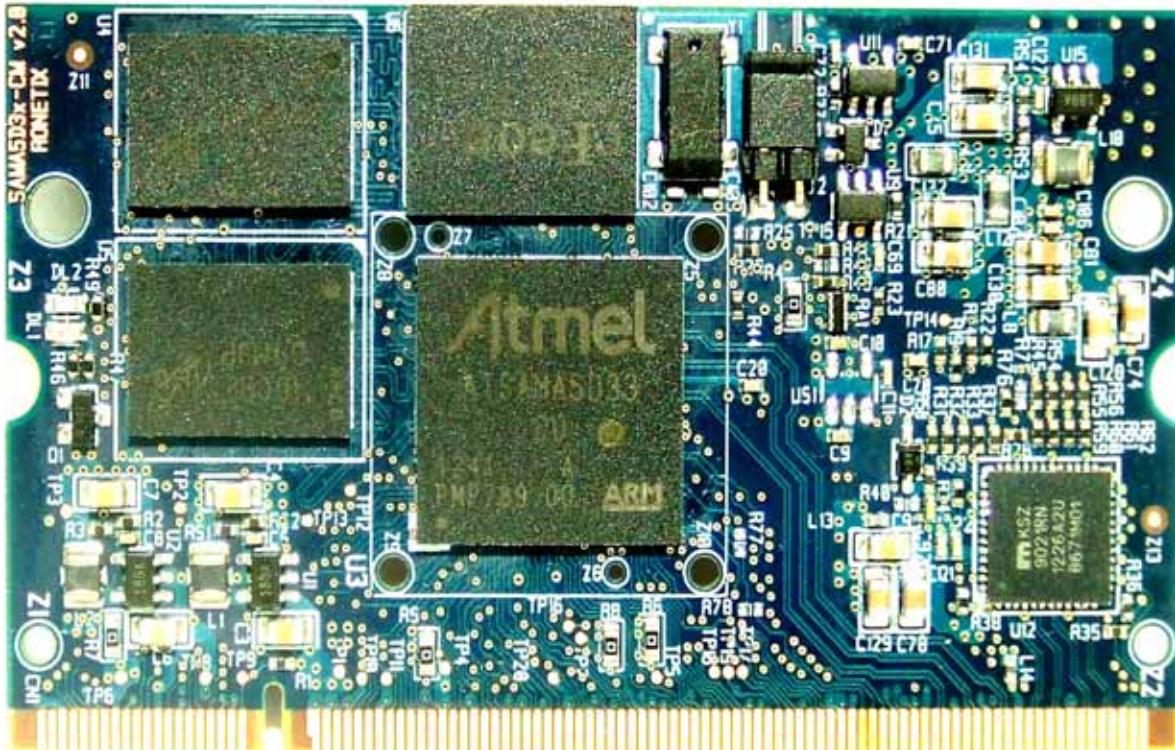
Figure 4-3. Board Architecture
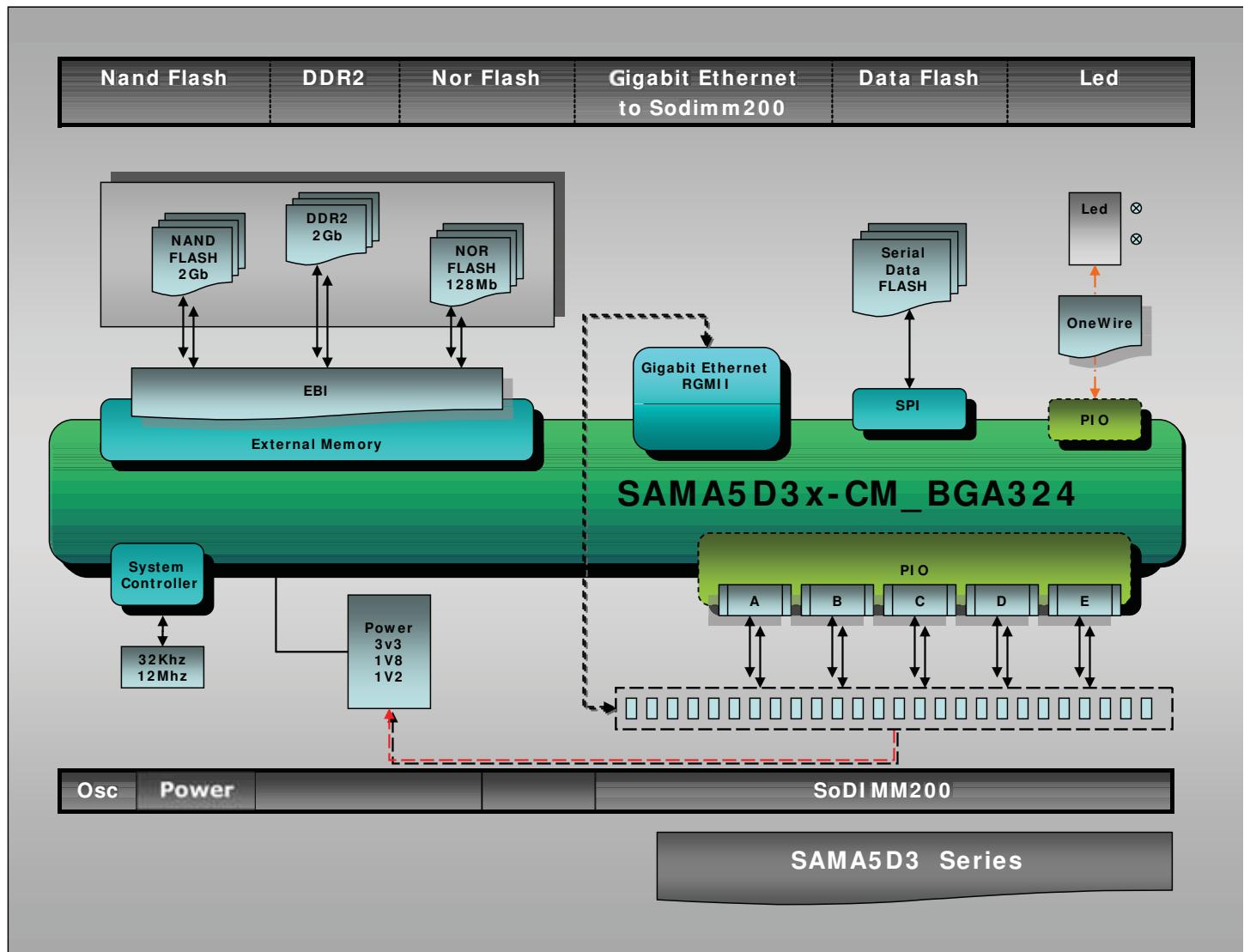
Note: Different interfaces on the main board share the same connections to the CPU module. The actual usage depends on the CPU module featured in your evaluation kit.

4.2 Equipment List

The CM board is built around an ARM® Cortex®-A5-based microcontroller (BGA 324 package) with external memory and Gigabit Ethernet PHYsical layer transceiver.

4.2.1 Devices

Table 4-2. CPU Module Specifications

Characteristic	Specifications
PCB	CPU Module (10 layers)
Dimensions in mm: (L x W x H)	67.60 *(40 to 47) * 5 max
Processor	SAMA5D31, SAMA5D33, SAMA5D34, SAMA5D35 and SAMA5D36 (324-ball BGA package)
Clock speed	12 MHz crystal 32.768 kHz
Memory	2 x DDR2 2 Gb 16 Meg x 16 x 8 banks 1 x SLC NAND Flash 2/4Gb 8-bit data 1 x NOR 128 Mb 16-bit data
On-board I/O Ports	One Serial EEPROM SPI One 1-Wire EEPROM DS2431 One user-powered red LED and one user blue LED One gigabit Ethernet PHY
Connector	SODIMM200
Board supply voltage	3.3V from SODIMM200 connector On-board power regulation
Temperature: - operating - storage	 0°C to +60°C -40°C to +85°C
Relative humidity	0 to 90% (non condensing)
RoHS status	Compliant
Board Identification Silkscreen top	SAMA5D31-CM SAMA5D33-CM SAMA5D34-CM SAMA5D35-CM SAMA5D36-CM

4.2.2 Interface Connection

● SODIMM200 card edge interface

4.2.3 Configuration Items

● One jumper for SPI DataFlash chip select connection

4.2.4 Boot Options

Table 4-3 lists the supported boot options

Table 4-3. Boot Options

Boot Mode	Boot Device	Type	Note
BMS OPEN	Embedded ROM Boot	ROM Boot followed by: - SPI0, NPCS0 - SD/MMC MCI0, MCI1 - NAND Flash - SPI0, NPCS1 - TWI0 - SAM-BA$^®$	Default boot is from embedded ROM
BMS CLOSE	NOR Flash	On-board NOR Flash using NCS0	Boot from external NOR Flash memory

4.2.4.1 Boot Configuration

In order to use SAM-BA boot, the NAND Flash and SPI DataFlash must be deselected.

Pressing the pushbutton PB4 (CS boot disable) disconnects these two components from the system while the ROM Boot is searching for a boot device after reset. A reset can be forced by pressing the PB1 (NRST) pushbutton. Note that PB1 and PB4 pushbuttons are located on the main board (MB).

In order to boot from SAM-BA, both PB1 and PB4 should be pressed, then PB1 released while PB4 is kept pressed until SAM-BA boots.

4.3 Functional Blocks

4.3.1 Processor

The CM board is equipped with one Atmel SAMA5D3 ARM-based embedded MPU from the list below:
- SAMA5D31
- SAMA5D33
- SAMA5D34
- SAMA5D35
- SAMA5D36

The SAMA5D3x devices are packaged in a BGA324-ball BGA package and share an identical footprint.

.As different interfaces can be defined using the same pins, the functions available on the evaluation board depend on the actual configuration of the CPU.

The Atmel SAMA5D3 series is a high-performance, power-efficient embedded MPU based on the ARM Cortex-A5 processor, achieving 536 MHz with power consumption levels below 0.5 mW in low-power mode. The device features a floating point unit for high-precision computing and accelerated data processing, and a high data bandwidth architecture. It integrates advanced user interface and connectivity peripherals and security features.

The SAMA5D3 series features an internal multi-layer bus architecture associated with 39 DMA channels to sustain the high bandwidth required by the processor and the high-speed peripherals. The device offers support for DDR2/LPDDR/LPDDR2 and MLC NAND Flash memory with 24-bit ECC.

The comprehensive peripheral set includes an LCD controller with overlays for hardware-accelerated image composition, a touchscreen interface and a CMOS sensor interface. Connectivity peripherals include Gigabit EMAC with IEEE1588, 10/100 EMAC, multiple CAN, UART, SPI and I2C. With its secure boot mechanism, hardware accelerated engines for encryption (AES, TDES) and hash function (SHA), the SAMA5D3 ensures anti-cloning, code protection and secure external data transfers.

Refer to Section 4. "CPU Module (CM) Board" on page 7 for details.

The processor runs at frequencies up to 536 MHz for the core and up to 166 MHz for the system bus.

4.3.2 Clock Circuitry

The CM board includes three clock sources:
- Two clocks are alternatives for the SAMA5D3 series processor main clock
- One crystal oscillator is used for the Ethernet RGMII chip

Table 4-4.   Main Components Associated with the Clock Systems

Quantity	Description	Component Assignment
1	Crystal for internal clock, 12 MHz	Y1
1	Crystal for RTC clock, 32.768 kHz	Y2
1	Oscillator for ethernet clock RGMII, 25 MHz	Y3

4.3.3 Reset Circuitry

The reset sources for the CM board are:
- Power-on reset
- Pushbutton reset (Pushbutton is equipped on main board)
- JTAG reset from an in-circuit emulator (MB features an on-board JTAG interface)

4.3.4 Power Supplies

The CM board is driven by +3.3V input power rail from the MB through the SODIMM200 connector. The CM board embeds all necessary power rails required for the microprocessor.

When additional voltages are required, they are generated on-board from the 3.3V supply (power source is a linear regulator or a switching regulator). The detailed power supply requirements for given modules are specified within the corresponding product documentation.

Table 4-5 summarizes the power specifications.

Table 4-5.   Supply Group Configuration

| Nominal	Name	Powers	Component
3.0V	VDDBU	the Slow Clock oscillator, the internal 32K RC, the internal 12M RC and a part of the System Controller	From VBAT 3V, SODIMM200 connector
3.3V	VDDIOP0	a part of peripheral I/O lines	From main 3.3V, SODIMM200 connector
3.3V	VDDIOP1	a part of peripheral I/O lines	From main 3.3V, SODIMM200 connector
3.3V	VDDUTMII	the USB device and host UTMI + interface	From main 3.3V, SODIMM200 connector
3.3V	VDDOSC	the main oscillator cells	From main 3.3V, SODIMM200 connector
3.3V	VDDANA	the analog-to-digital converter	From main 3.3V, SODIMM200 connector
1.2V	VDDCORE	the core, including the processor, the embedded memories and the peripherals	Regulator on-board
1.2V	VDDUTMIC	the USB device and host UTMI + core	Regulator on-board
1.2V	VDDPLLA	the PLLA cell	Regulator on-board
1.8V	VDDIODDR	DDR2 interface I/O lines	Regulator on-board
1.8V	VDDIOM	NAND, NOR Flash and SMC interface I/O lines	Regulator on-board
3.0V to 3.3V	ADVREF	ADC reference voltage	From ADVREF, SODIMM200 connector
2.5V	VDDFUSE	Fuse box for programming	Regulator on-board

Figure 4-4. Embest/Flextronics Power Supply
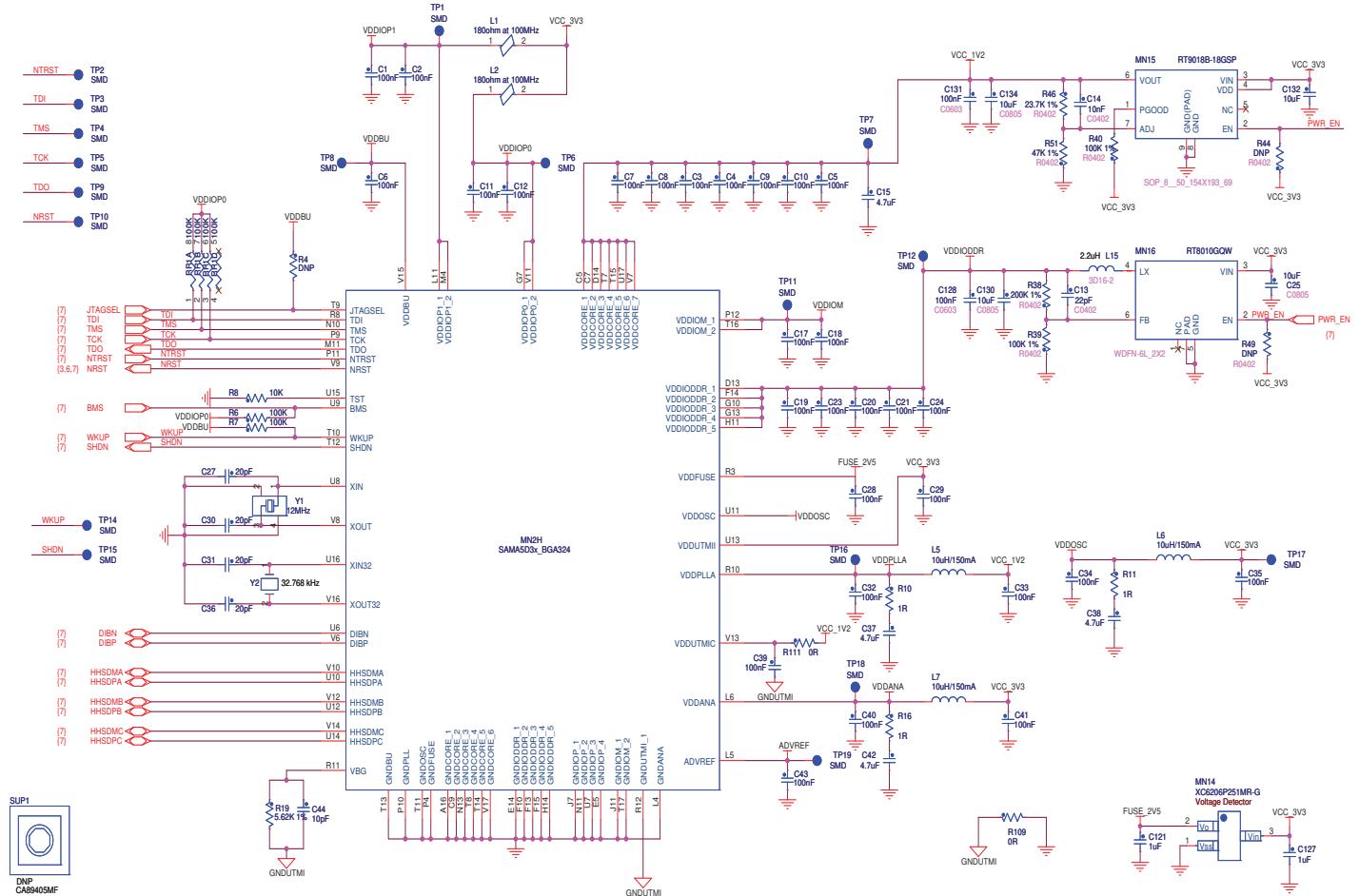
**Figure 4-5.   Ronetix Power Supply**
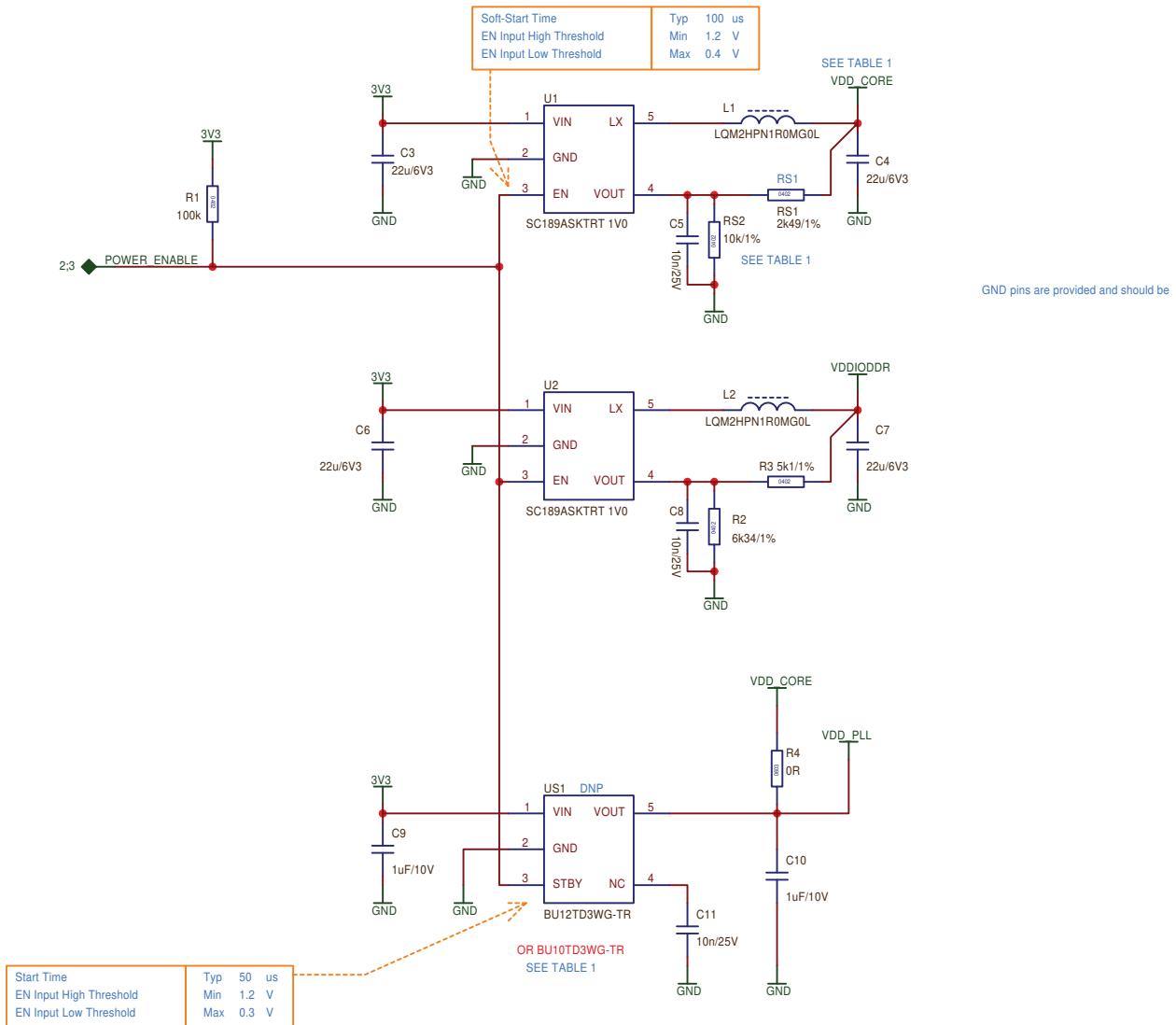
Figure 4-6. Ronetix Power Supply (Continued)
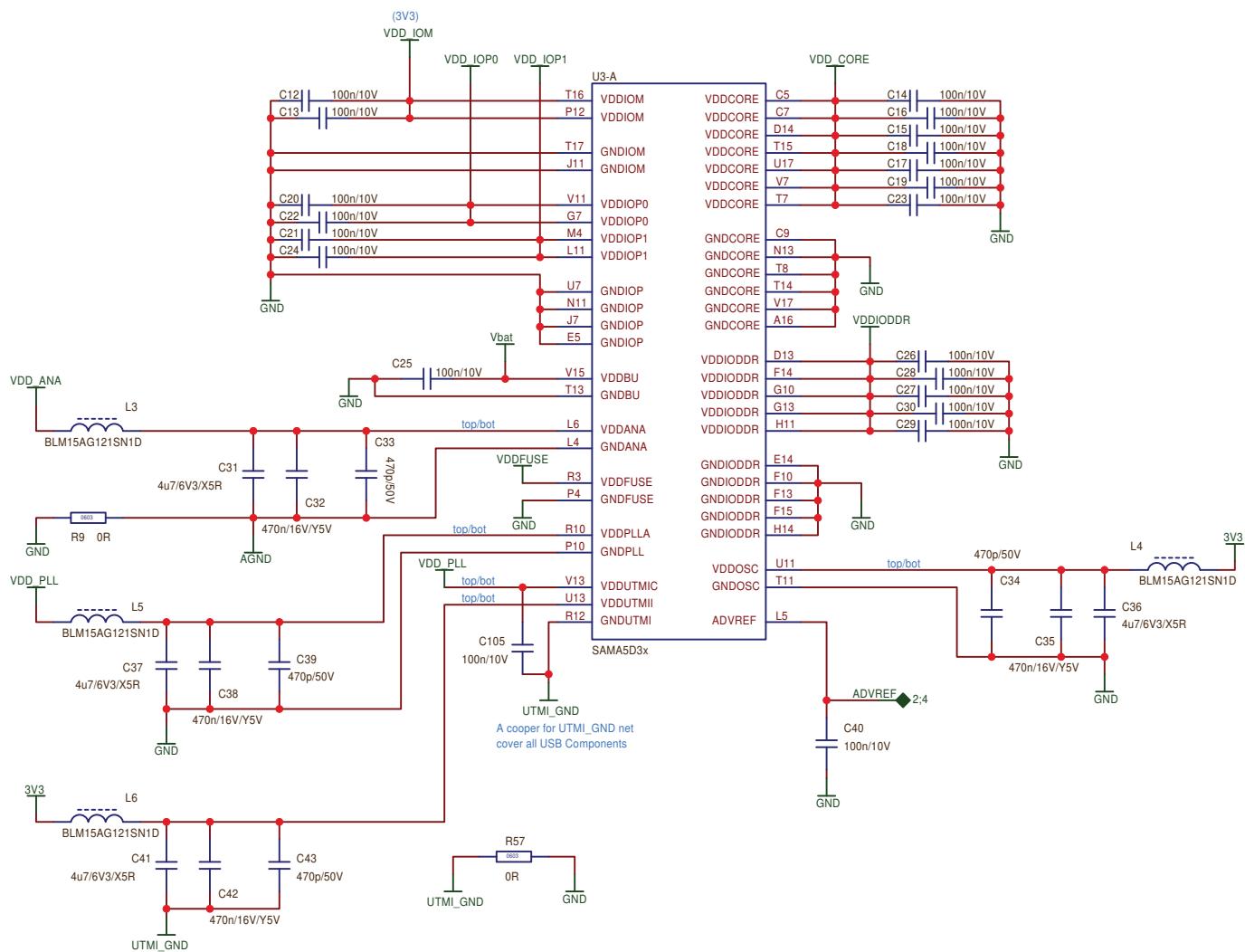
4.3.5 Memory

4.3.5.1 Memory Organization

The SAMA5D3 series processor features a DDR/SDR memory interface and an External Bus Interface (EBI) to interface to a wide range of external memories and to almost any kind of parallel peripheral.

4.3.5.2 Resource Allocation

This section describes the memory devices that equip the SAMA5D3 series CM board.

- Two SDRAM/DDR2 are used as main system memory. MT47H128M16 - 2 Gb - 16 Meg x 16 x 8 banks, the board provides up to 2 Gb of on-board, soldered DDR2 SDRAM. The memory bus is 32 bits wide and operates at up to 166 MHz.

Figure 4-7.   Embest/Flextronics DDR2 Memory
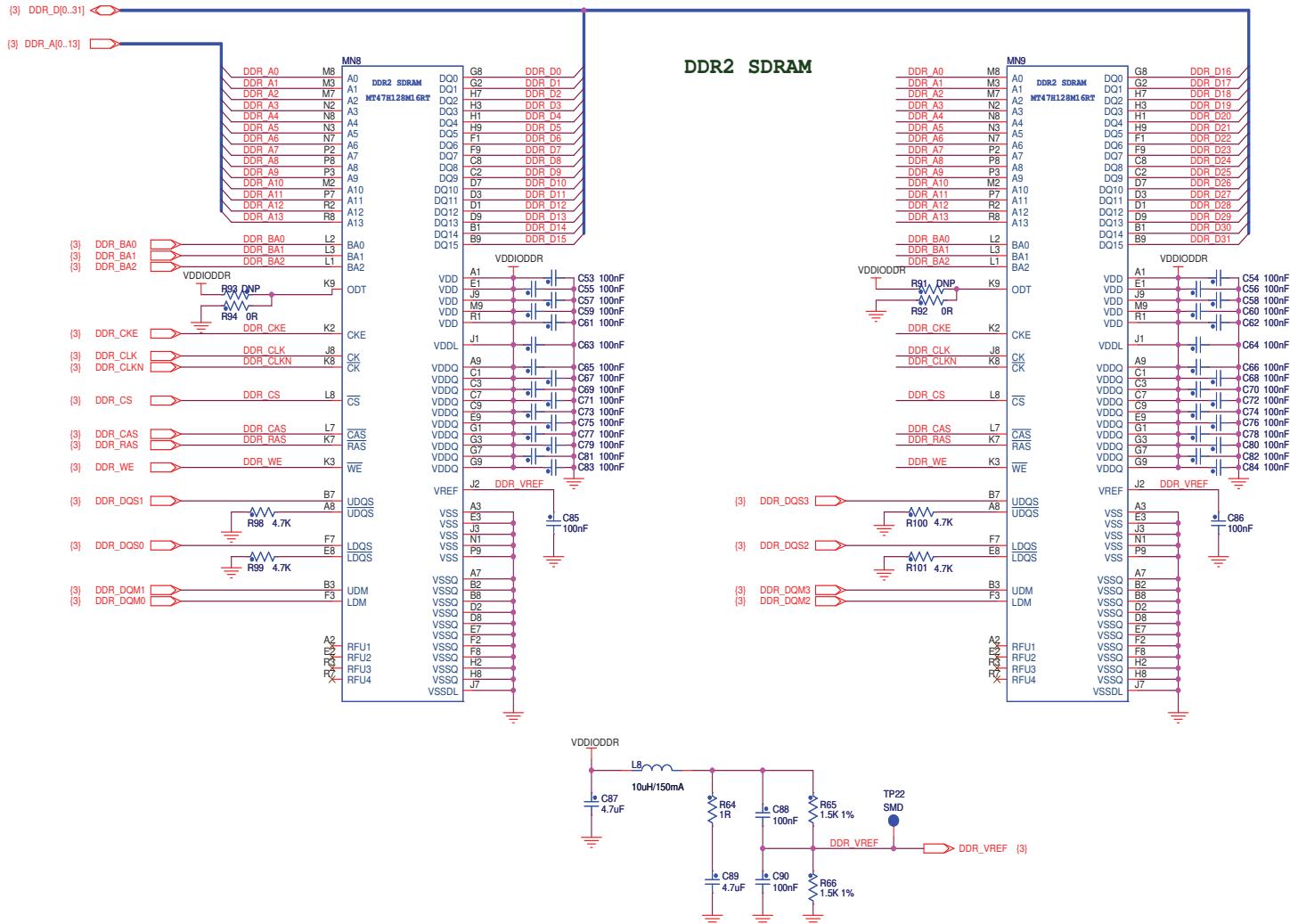
Figure 4-8. Ronetix DDR2 Memory
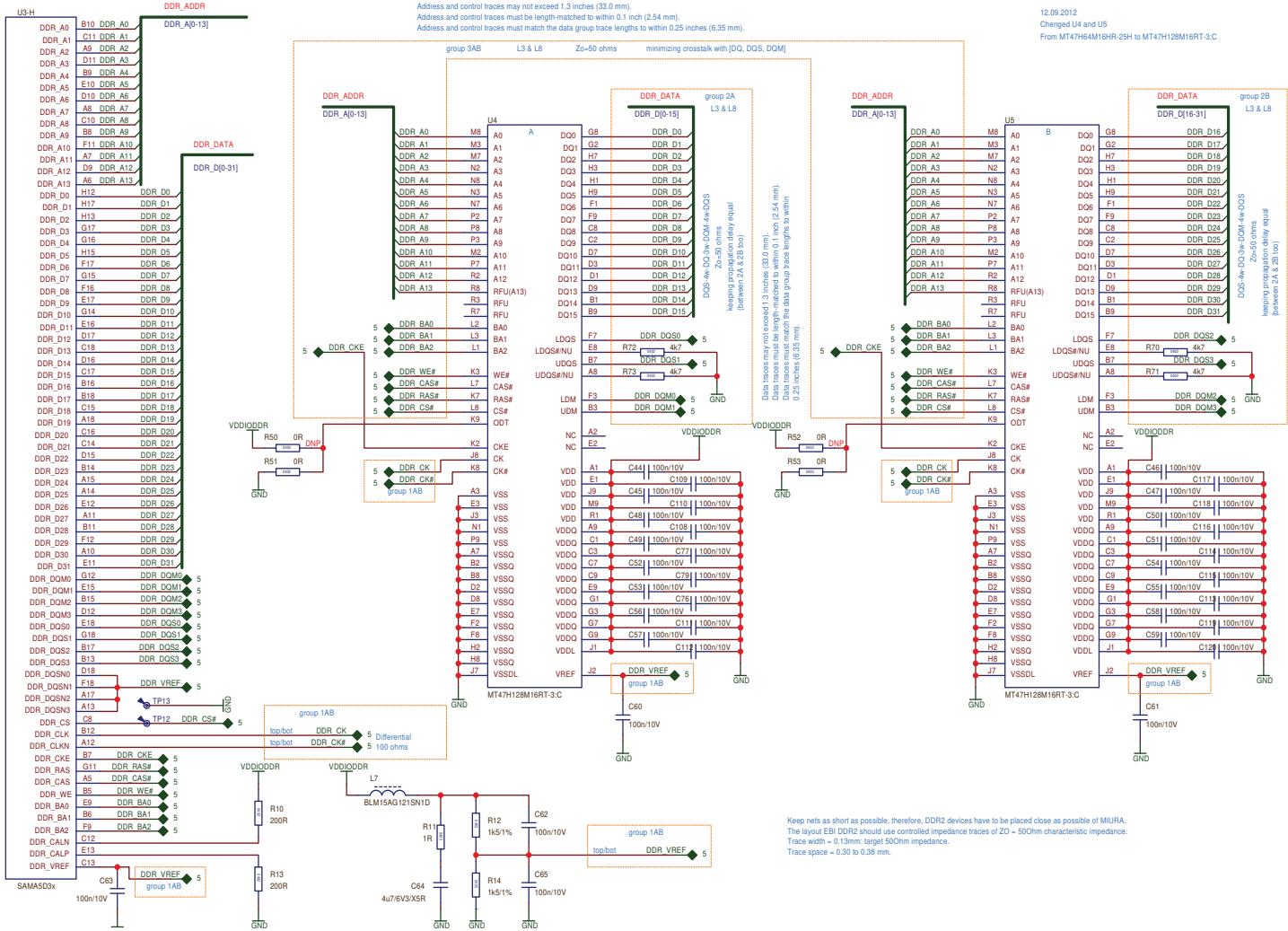
- One NAND Flash: NAND is connected to the processor. Maximum size is 256 bytes.
- One NOR Flash (optional, not populated): NOR Flash is 16 bits wide. Maximum size is 128 Mbytes.

**Figure 4-9.** Embest/Flextronics External Memory
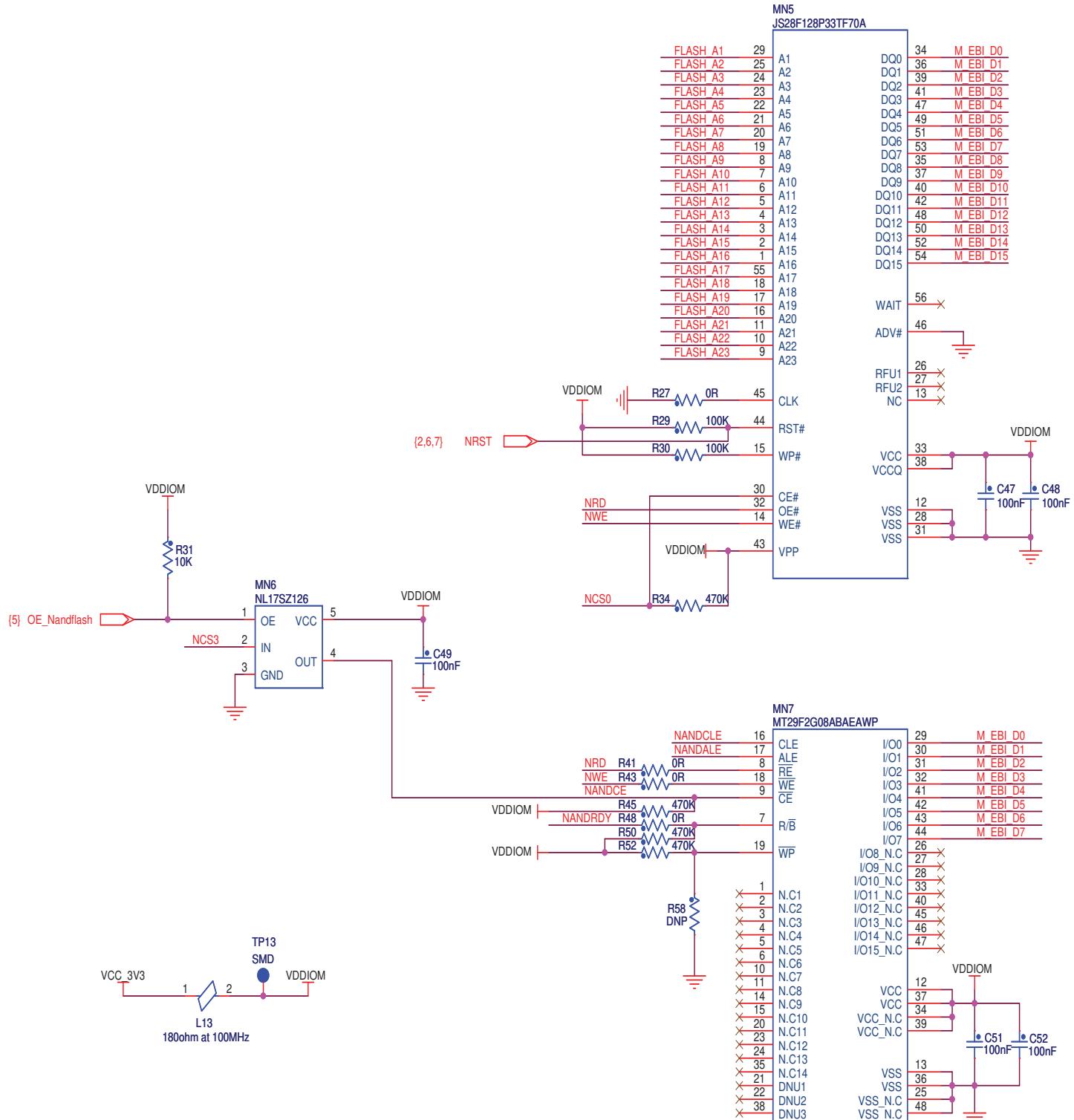
Figure 4-10. **Ronetix External Memory**
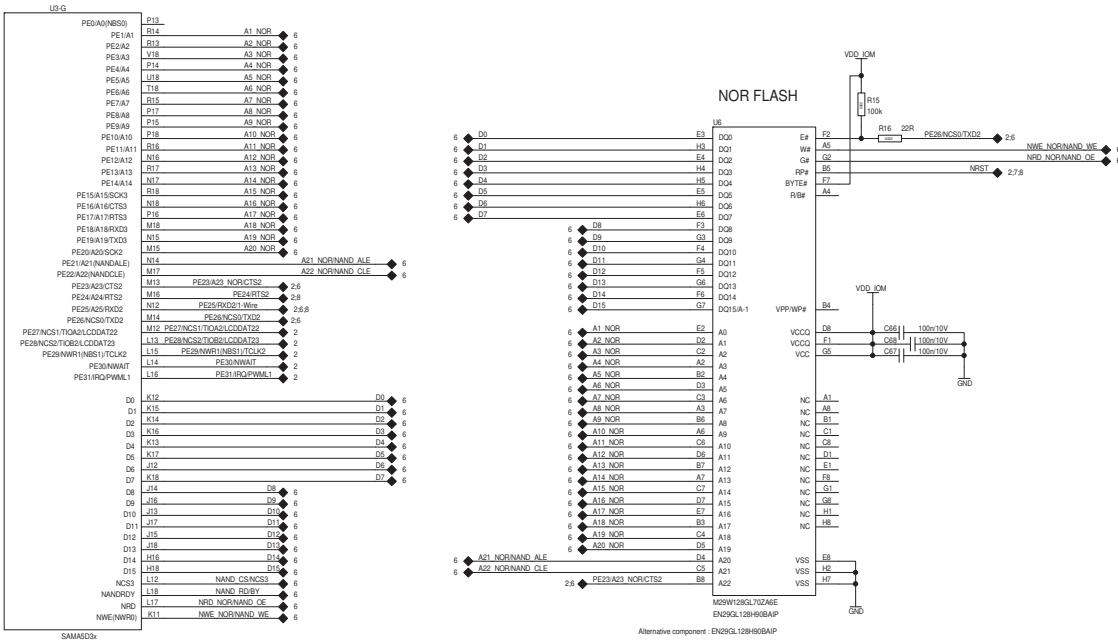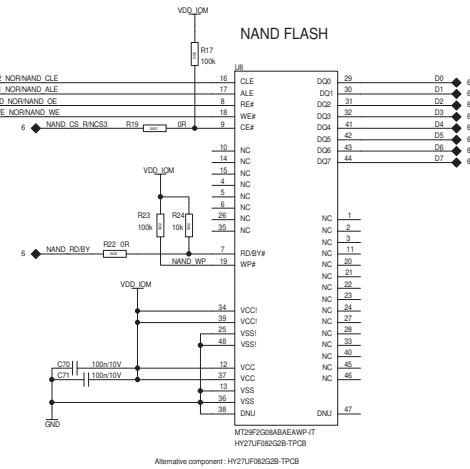
4.3.6 Serial Peripheral Interface Controller (SPI)

The SAMA5D3 series processor provides two high-speed Serial Peripheral Interface (SPI) controllers. One port is used to interface with the on-board serial DataFlash. Note that the on-board serial DataFlash is enabled through a jumper: JP1 on Embest modules, J1 on Ronetix modules. The jumper must be in place access (and boot) the serial DataFlash.

Figure 4-11.   Embest/Flextronics Serial DataFlash on SPI
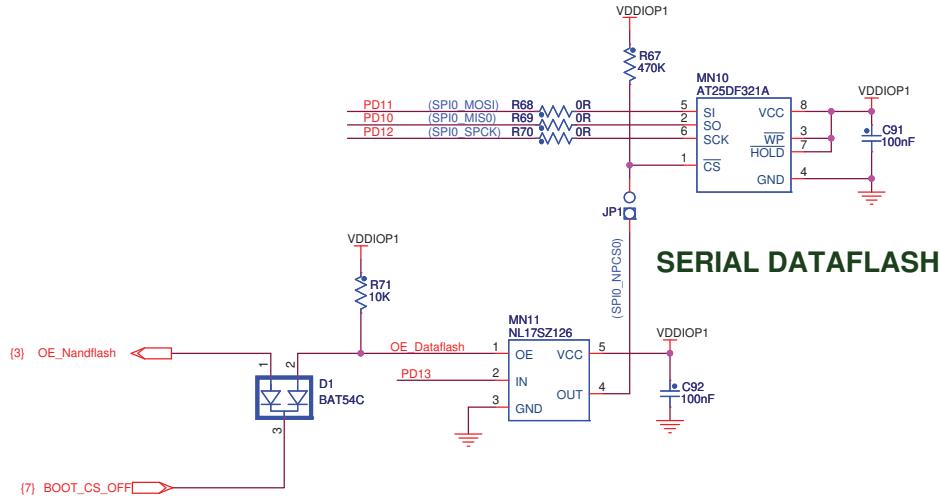
Figure 4-12.   Ronetix Serial DataFlash on SPI
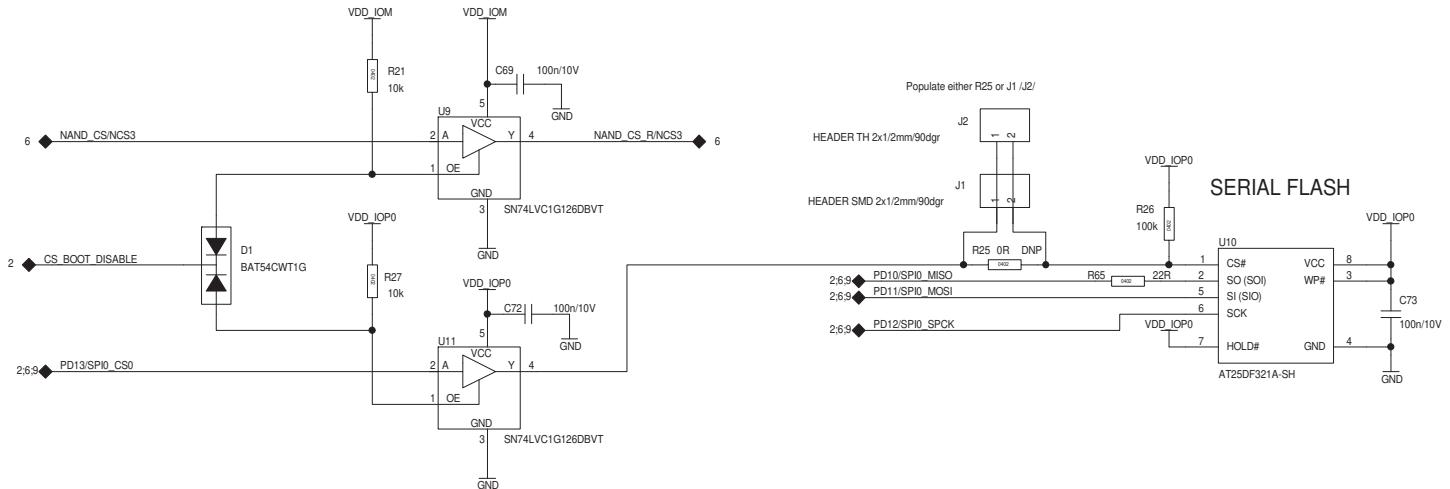
4.3.7   1-Wire EEPROM

The SAMA5D3 series CM board uses a 1-wire device as a "soft label" to store information such as chip type, manufacture name, production date, etc.

Only page 1 is used.

Warning: Do not modify the information contained in this page.

Pages 2 to n remain free for the user.

Figure 4-13.   Embest 1-Wire EEPROM
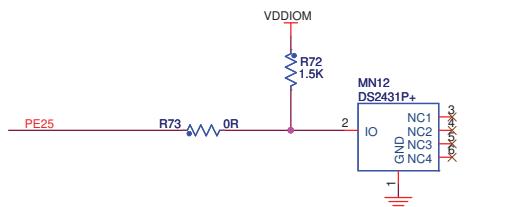
Figure 4-14.   Ronetix 1-Wire EEPROM
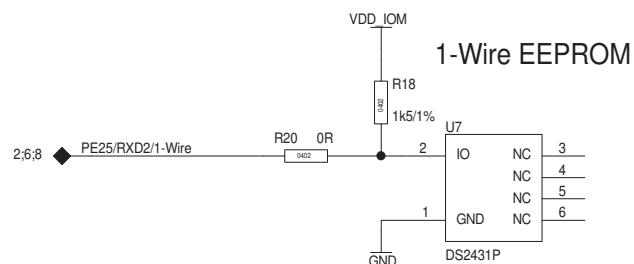
4.3.8 Tri-Speed Ethernet PHY

The SAMA5D3 series CM board is equipped with a MICREL PHY device (MICREL KSZ9021/31) operating at 10/100/1000 Mbps. The board supports the RGMII interface mode. The Ethernet interface consists of four pairs of low-voltage differential pair signals designated from GRX± and GTx± plus control signals for link activity indicators. These signals can be used to connect to a 10/100/1000 Base-T RJ45 connector integrated on the main board.

For more information about the Ethernet controller device, refer to the MICREL KSZ89021RN controller manufacturer's datasheet.

Figure 4-15. Embest/Flextronics GEthernet ETH0
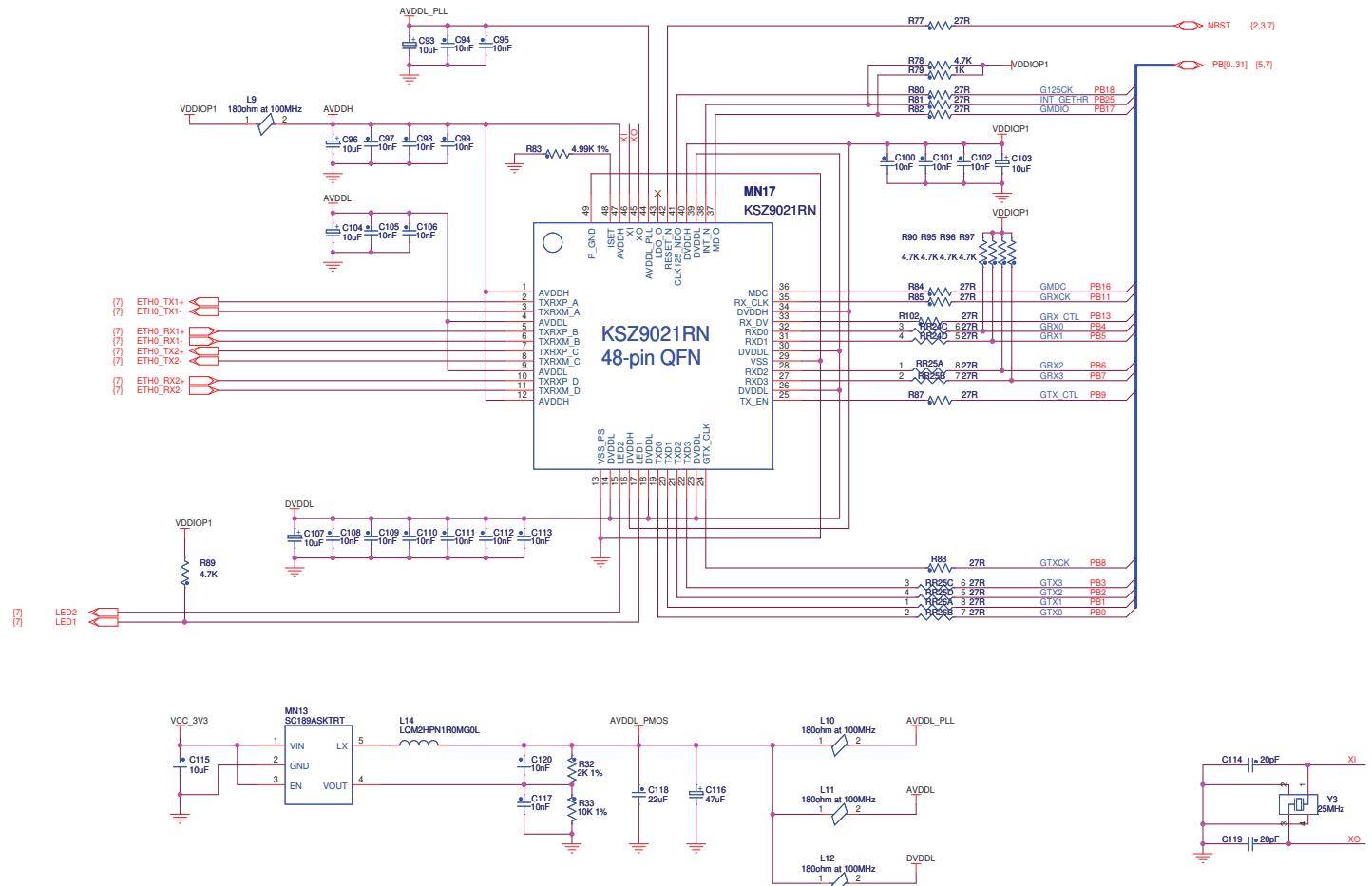
Figure 4-16. **Ronetix GEthernet ETH0**
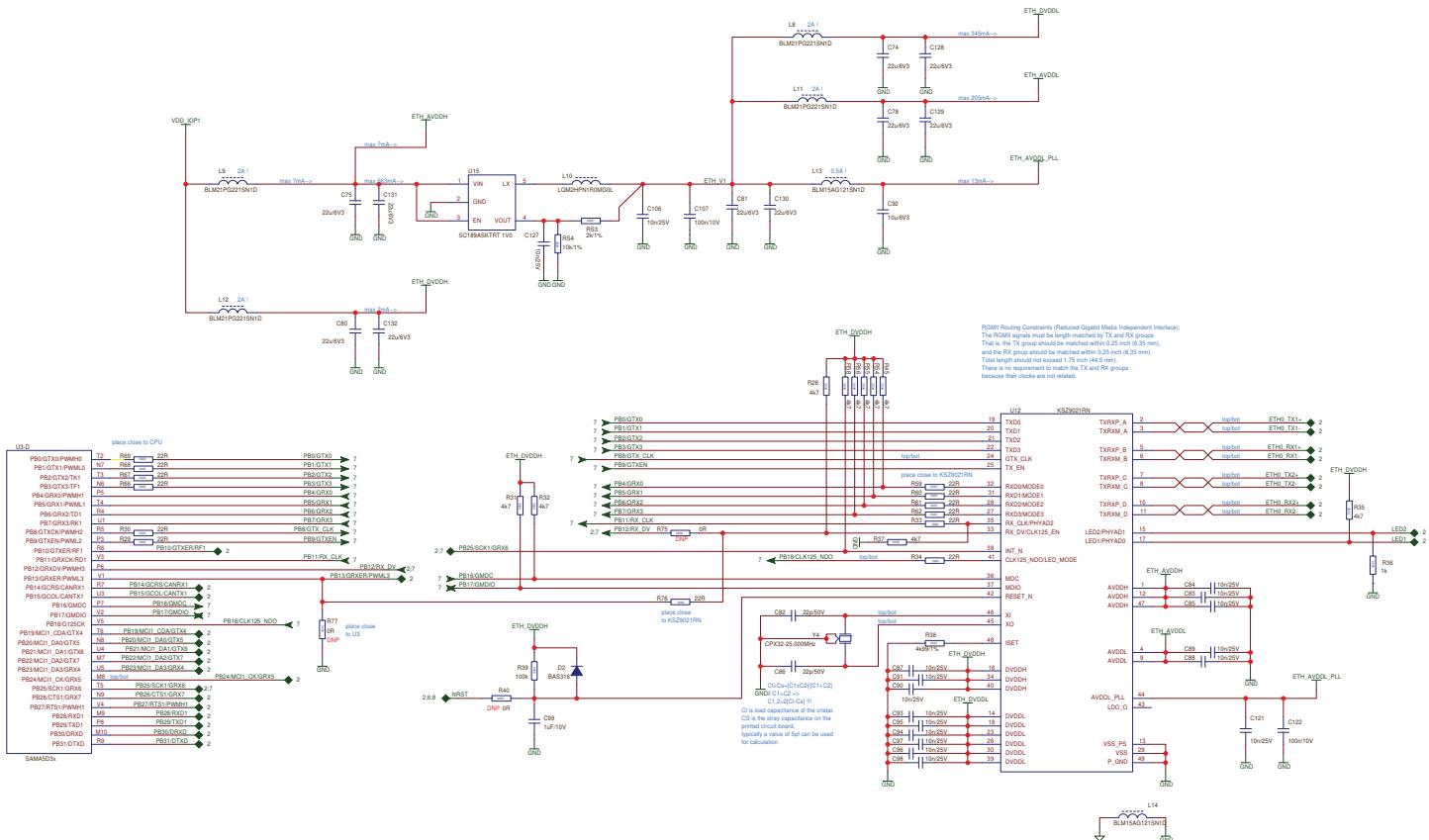
4.3.9 Indicators

There are two LEDs on the SAMA5D3 series CM board that can be controlled by the user. Both are controlled by GPIO lines PE24 and PE25 as shown below.

Figure 4-17.   Embest/Flextronics LED Indicators
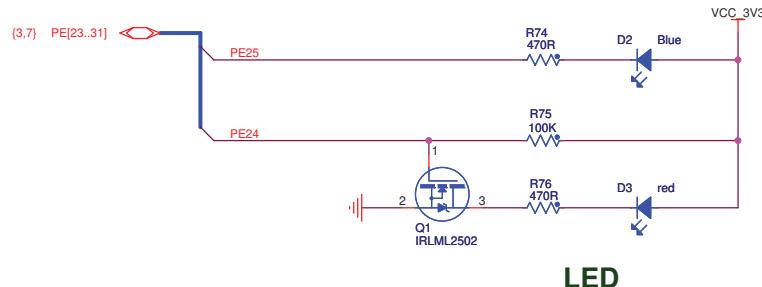
Figure 4-18.   Ronetix LED Indicators