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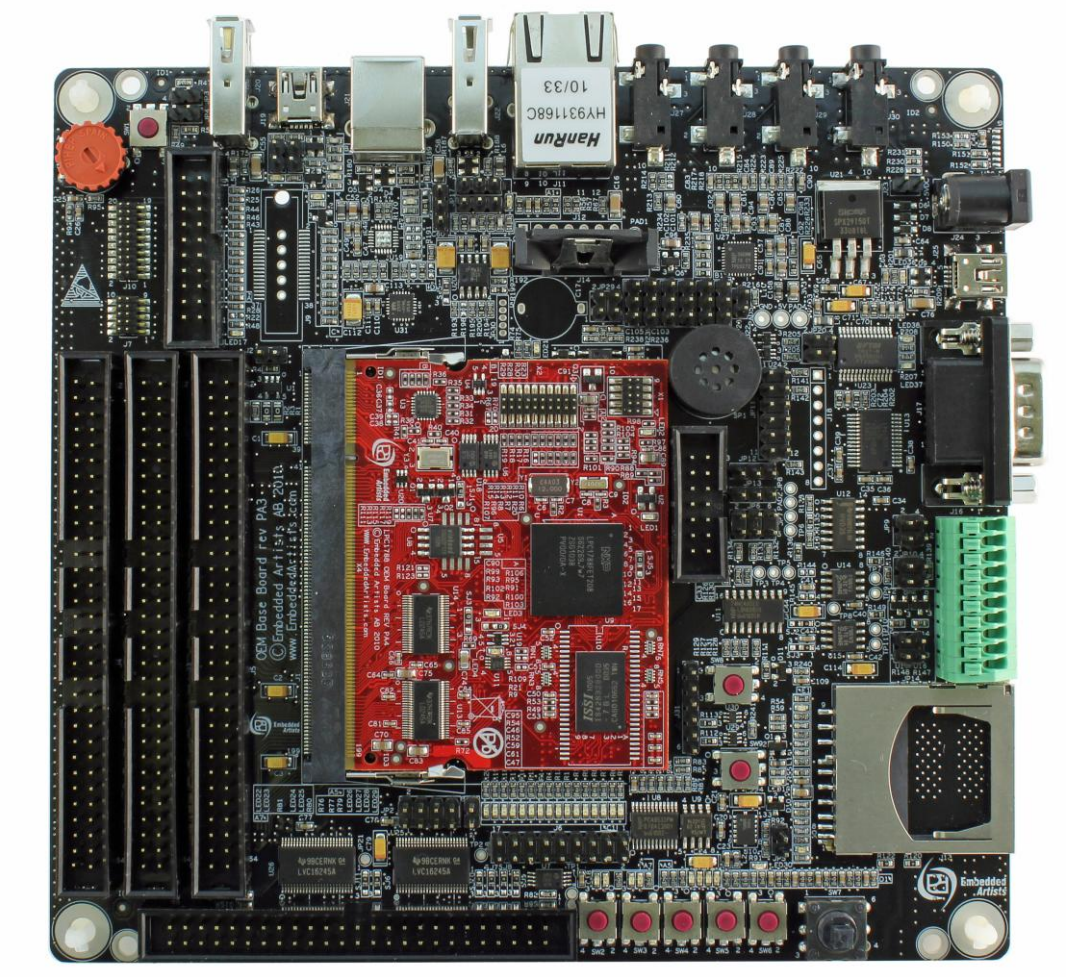
# LPC4088 Developer's Kit User's Guide



*Get Up-and-Running Quickly and*
*Start Developing Your Application On Day 1!*

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# Table of Contents

# 1 Document Revision History

| *Revision* | *Date* | *Description* |
|---|---|---|
| PA1 | 2012-03-29 | First version. |
| PA2 | 2012-05-03 | Minor clarifications. |
| PA3 | 2012-07-03 | Added information how to solve humming in speaker. |
| PA4 | 2012-11-08 | Clarified information in section 3.5 (configuration E2PROM). |
| PA5 | 2012-12-04 | Added information about warm reset and the Ethernet PHY. |

# 2 Introduction

Thank you for buying Embedded Artists' *LPC4088 Developer's Kit* based on NXP's ARM Cortex-M4 LPC4088 microcontroller.

This document is a User's Guide that describes the *LPC4088 OEM Board* and the OEM *Base Board* hardware design, which together form the *LPC4088 Developer's Kit.*

## 2.1 Features

Embedded Artists' *LPC4088 OEM Board* lets you get up-and-running quickly. The small form factor OEM board offers many unique features that ease your learning curve and program development. The board has been designed for OEM applications with volume discount available.

- NXP's ARM Cortex-M4 LPC4088 microcontroller in BGA package, with 512 KByte program FLASH and 96 KByte SRAM
- 32 MBit QSPI flash on SPIFI interface
- External FLASH memories: 128 MB NAND FLASH
- External data memory: 32 MB SDRAM (normally 32-bit databus width, 16-bit version exist as special order)
- 12.0000 MHz crystal for maximum execution speed and standard serial bit rates, including CAN and USB requirements
- 32.768kHz RTC crystal
- 100/10M Ethernet PHY/interface based on SMSC LAN8720
- Buffered 32- (or 16-)bit data bus for external expansion
- 200 pos expansion connector (SODIMM-200 format, 0.6mm pitch)
  - All LPC4088 pins available (except a few used for Ethernet-PHY interface)
- +3.3V only powering
- Onboard reset generation
- Compact SODIMM format: 68 x 50 mm
  - Six layer PCB design for best EMC performance

There is an accompanying *OEM Base Board* that can be used for initial prototyping work. The features of the board are:

- Interfaces and Connectors
  - 200 pos, 0.6mm pitch SODIMM connector for *OEM Board*
  - LCD expansion connector with control signals for touch screen interface
  - Expansion connector with all *OEM Board* signals
  - Ethernet connector (RJ45)
  - CAN interface & connector (provision for second CAN interface, but not mounted)
  - MMC/SD interface & connector
  - USB1: OTG or Host interface & connector

  - USB2: Device or Host interface & connector
  - Provision for NXP JN5148 RF module (former Jennic) interface (RF module not included)
  - Full modem RS232 (cannot be fully used on 32-bit databus OEM boards)
  - RS422/485 interface & connector
  - Provision for IrDA transceiver interface (transceiver not mounted)
  - I2S audio codec (mic in, line in, line out, headphone out)
  - SWD/JTAG connector
  - Trace connector
- Power
  - Power supply, either via USB or external +5V DC
  - Coin cell powering supported (CR1025 battery not included) for RTC and LED on ALARM output.
- Other
  - *OEM Board* current measuring
  - Parallel NOR flash on external memory bus
  - 16-bit register and LEDs on external memory bus
  - 5-key joystick
  - 3-axis accelerometer (I2C connected)
  - LM75 temperature sensor (I2C connected)
  - 5 push-button keys (four via I2C and one on P2.10)
  - 9 LEDs (8 via I2C and one on P2.10)
  - Analog input
  - USB-to-serial bridge on UART #0 (FT232R) and ISP functionality
  - Reset push-button and LED
  - Speaker output on analog output from *OEM Board*, or from I2S audio codec
  - Compact size: 160x150 mm

## 2.2 ESD Precaution

Please note that the *LPC4088 OEM Board* and *OEM Base Board* come without any case/box and all components are exposed for finger touches – and therefore extra attention must be paid to ESD (electrostatic discharge) precaution.

***Make it a habit always to first touch the metal surface of one of the USB or Ethernet connectors for a few seconds with both hands before touching any other parts of the boards.*** That way, you will have the same potential as the board and therefore minimize the risk for ESD.

Never touch directly on the *LPC4088 OEM Board* and in general as little as possible on the *OEM Base Board*. The push-buttons on the *OEM Base Board* have grounded shields to minimize the effect of ESD.

***Note that Embedded Artists does not replace boards that have been damaged by ESD.***

## 2.3 General Handling Care

Handle the *LPC4088 OEM Board* and *OEM Base Board* with care. The boards are not mounted in a protective case/box and are not designed for rough physical handling. Connectors can wear out after excessive use. The *OEM Base Board* is designed for prototyping use, and not for integration into an end-product.

For boards with LCD, do not exercise excessive pressure on the LCD glass area. That will damage the display. Also, do not apply pressure on the flex cables connecting the LCD/touch screen. These are relatively sensitive and can be damaged if too much pressure is applied to them.

***Note that Embedded Artists does not replace boards where the LCD has been improperly handled.***

## 2.4 Code Read Protection

The LPC4088 has a Code Read Protection function (specifically CRP3, see datasheet for details) that, if enabled, will make the LPC4088 impossible to reprogram (unless the user program has implemented such functionality).

***Note that Embedded Artists does not replace LPC4088 OEM boards where the LPC4088 has CRP3 enabled. It's the user's responsibility to not invoke this mode by accident.***

## 2.5 CE Assessment

The *LPC4088 Developers Kit* (consisting of the *LPC4088 OEM Board* and *OEM Base Board*) is CE marked. See separate *CE Declaration of Conformity* document.

The *LPC4088 Developers Kit* is a class A product. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

EMC emission test has been performed on the *LPC4088 Developers Kit*. Standard interfaces like Ethernet, USB, serial have been in use. General expansion connectors where internal signals are made available (for example processor pins) have been left unconnected. Connecting other devices to the product via the general expansion connectors may alter EMC emission. It is the user's responsibility to make sure EMC emission limits are not exceeded when connecting other devices to the general expansion connectors of the *LPC4088 Developers Kit*.

Due to the nature of the *LPC4088 Developers Kit* – an evaluation board not for integration into an end-product – fast transient immunity tests and conducted radio-frequency immunity tests have not been executed. Externally connected cables are assumed to be less than 3 meters. The general expansion connectors where internal signals are made available do not have any other ESD protection than from the chip themselves. Observe ESD precaution.

Note that the *LPC4088 OEM* board is classified as a component and is hence not CE marked separately. It can perform different functions in different integrations and it does not have a direct function. It is therefore not in the scope of the CE Directive. An end product, where an *OEM Board* is integration into, is however very likely to need CE marking.

## 2.6 Other Products from Embedded Artists

Embedded Artists have a broad range of LPC1000/2000/3000/4000 based boards that are very low cost and developed for prototyping / development as well as for OEM applications. Modifications for OEM applications can be done easily, even for modest production volumes. Contact Embedded Artists for further information about design and production services.

### 2.6.1 Design and Production Services

Embedded Artists provide design services for custom designs, either completely new or modification to existing boards. Specific peripherals and I/O can be added easily to different designs, for example, communication interfaces, specific analog or digital I/O, and power supplies. Embedded Artists has a broad, and long, experience in designing industrial electronics in general and with NXP's

LPC1000/2000/3000/4000 microcontroller families in specific. Our competence also includes wireless and wired communication for embedded systems. For example IEEE802.11b/g (WLAN), Bluetooth™, ZigBee™, ISM RF, Ethernet, CAN, RS485, and Fieldbuses.

### 2.6.2 OEM / Education / QuickStart Boards and Kits

Visit Embedded Artists' home page, www.EmbeddedArtists.com, for information about other *OEM* / *Education* / *QuickStart* boards / kits or contact your local distributor.

# 3 LPC4088 OEM Board Design

Please read the *LPC4088 OEM Board* datasheet and associated schematic for information about the board. Some additional information about the *LPC4088 OEM Board* is presented below.

## 3.1 Memory Layout

The external memory controller on the LPC4088 defines eight memory regions. See table below for details about usage.

| ***Name*** | ***Control signal*** | ***Address range*** | ***Memories on LPC4088 OEM Board*** | ***External memory bus comment*** |
|---|---|---|---|---|
| Static memory #0 | CS0 | 0x8000 0000 – 0x83FF FFFF | | Available for external use.<br>*OEM Base Board* can connect a parallel NOR flash to this chip select. |
| Static memory #1 | CS1 | 0x9000 0000 – 0x93FF FFFF | NAND FLASH (1 GBit = 128 MByte in size) | Not available for external use.<br>It is however possible to disable NAND flash chip by removing R57 on *LPC4088 OEM Board*. |
| Static memory #2 | CS2 | 0x9800 0000 – 0x9BFF FFFF | | Available for external use.<br>*OEM Base Board* can connect a 16-bit parallel register to this chip select. |
| Static memory #3 | CS3 | 0x9C00 0000 – 0x9FFF FFFF | | Available for external use. |
| Dynamic memory #0 | DYCS0 | 0xA000 0000 – 0xAFFF FFFF | SDRAM (256 MBit = 32 MByte in size) | Cannot be accessed on external memory bus. |
| Dynamic memory #1 | DYCS1 | 0xB000 0000 – 0xBFFF FFFF | | Cannot be accessed on external memory bus. |
| Dynamic memory #2 | DYCS2 | 0xC000 0000 – 0xCFFF FFFF | | Cannot be accessed on external memory bus. |
| Dynamic memory #3 | DYCS3 | 0xD000 0000 – 0xDFFF FFFF | | Cannot be accessed on external memory bus. |

As seen in the table above, it is only the static memory regions that are available on the external memory bus from the *LPC4088 OEM Board*. The data bus buffers on the *LPC4088 OEM Board* are controlled automatically and only enabled when a static memory region is accessed. The address and control bus buffers are always enabled.

Note that the BLS0, BLS1, BLS2 and BLS3 pins must be initialize for these functionalities. Else the buffer control will not work correctly.

### 3.1.1 NAND Flash

Note that the NAND flash is connected after the memory bus buffers, i.e., on the same side as the LPC4088 OEM Board expansion signals. This is to allow flexibility in NAND flash usage and reduce loading on memory bus that is directly connected to the SDRAM.

The NAND FLASH has an optional busy output that can be used for controlling the erase/program operations with better precision. The signal is available on the expansion connector. If needed, the signal can be routed to a suitable (i.e., free) input pin. The *OEM Base Board* can connect the signal to GPIO72 by inserting a jumper between pin 3-4 on JP2. The busy status of the chip is also available under software control.

## 3.2 SPIFI

There is a 32 MBit QSPI flash connected to the SPIFI interface of the LPC4088.

## 3.3 LEDs

P2.26 and P2.27 controls two LEDs on the *LPC4088 OEM Board*. This control can be disabled via SJ4 (shorting pad 2-3 instead of the default 1-2). There is no real need to disable this control unless the reason is to save power. The LED driving is isolated via buffers so P2.26 and P2.27 are not loaded because of this.

## 3.4 Board Options

The schematic for the *LPC4088 OEM Board* show many options. The design has been prepared for customized versions for different needs. The board can for example be built with 16-bit databus width. The SWD/JTAG and trace connectors are not soldered by default, but can be for custom orders. It is also possible to mount a uSD memory card connector instead of the NAND flash controlled by CS1.

## 3.5 Configuration E2PROM

The *LPC4088 OEM Board* contains a configuration e2prom that can be accessed via I2C. The memory is write-protected so that the information is not deleted by accident. The memory is empty when delivered but it can be used to store information about the design revision, board configuration and Ethernet MAC address.

## 3.6 Migrating to LPC4088 from LPC1788

The LPC4088 is the Cortex-M4 version of LPC1788 (Cortex-M3 core). These chips are very compatible and the LPC4088 and LPC1788 OEM boards are very similar. The differences are listed below:

- A 32 Mbit QSPI flash is connected to the SPIFI interface of the LPC4088. This locks usage of pins: P0.15, P0.16, P0.17, P0.18, P0.22 and P2.7.
- SODIMM connector, pin 32 carries P0.10 (instead of P2.7, which is used by the SPIFI interface).
- SODIMM connector, pin 57 carries P4.22 (instead of P0.10, which is used by the SPIFI interface).
- SODIMM connector, pin 58 carries P4.23 (instead of P0.11, which is used by the SPIFI interface).
- SODIMM connector, pin 62 carries P5.2 (instead of P0.15, which is used by the SPIFI interface).
- SODIMM connector, pin 63 carries P5.3 (instead of P0.16, which is used by the SPIFI interface).

- SODIMM connector, pin 64 carries P5.1 (instead of P0.17, which is used by the SPIFI interface).
- SODIMM connector, pin 65 carries P5.0 (instead of P0.18, which is used by the SPIFI interface).
- The user accessible 256 Kbit $I^2C$-$E^2PROM$ has been removed since the LCP4088 contains an on-chip $E^2PROM$.
- Pins P5.2 and P5.3 are open-drain pins (with 1.5Kohm pull-up resistors on the board).

Only minor program adjustments have to be done to handle these differences between the boards.

## 3.7 Migrating to LPC4088 from LPC2478

The LPC4088 can be viewed as the Cortex-M4 version of LPC2478 (ARM7TMDI core). NXP have in general made the chips very compatible. The LPC4088 is newer design and recommended for new designs. The maximum clock frequency is also higher allowing for more tasks to be handled.

Below are the things to consider when migrating to an LPC4088 OEM boards from an LPC2478 OEM board:

- There is an application note from NXP describing the general issues when migrating; *AN10878 Migrating to the LPC1700 series*. There are both hardware and software issues to consider. It involves more than just recompiling the code. This application note is relevant also for the LPC4088 (since it builds on the LPC1788 design).
- The LPC4088 OEM board is physically 2 mm higher (50mm instead of 48 mm).
- The Ethernet-PHY on the LPC4088 OEM board is different (LAN8720 from SMSC instead of DP83848 from National/TI).
- There are LEDs connected to pins P2.26 and P2.27 on the LPC4088 OEM board. This is normally not a problem since the LEDs can be disabled also.
- There is no 32 Mbit NOR FLASH on the LPC4088 OEM board. Instead there is a 32 Mbit QSPI flash.
- The LPC4088 OEM board only allows static memory region expansion, as opposed to the LPC2478 OEM board that allows both static and dynamic memory regions to be expanded on the external memory bus. This change has the benefit of simplifying expansion of static memories, which is the most common anyways. On the LPC2478 OEM boards the databus buffers has to be controlled by an external circuit (to enable the buffers when an external memory region was accessed. With wrong control it was possible to mess up the internal databus.
  On the LPC4088 OEM board the databus buffers are controlled automatically on the boards. Whenever a static memory region is accessed the databus buffers are enabled.
- There are a few changes in pinning, see table below. Most of the changes are related to the new port P5 of the LPC4088 and the change in external memory bus expansion (only allowing expansion of static memory regions).
  In most cases the LPC4088 OEM board can replace a LPC2478 OEM board without any (hardware) problems.

| *Pin* | *LPC4088 OEM Board* | *LPC2478 OEM Board* | *Reason for change* |
|---|---|---|---|
| 13 | NC | Ethernet power down input | The new Ethernet-PHY (LAN8720) does not contain a power down input (can be |

| | | | |
|---|---|---|---|
| | | | done via software instead) |
| 14 | P5.0 | DBGEN | The LPC4088 does not have a DBGEN (debug enable) input.<br>The LPC4088 has a new port P5. |
| 16 | P5.4 | RTCK | The LPC4088 does not have the RTCK signal.<br>The LPC4088 has a new port P5. |
| 32 | P0.10 | P2.7 | P2.7 is locked by SPIFI interface. |
| 57 | P4.22 | P0.10 | P0.10 needed in pin 32. |
| 58 | P4.23 | P0.11 | Change to same UART channel as P4.22 carries (see pin 57). |
| 62 | P5.2 | P0.15 | P0.15 is locked by SPIFI interface. |
| 63 | P5.3 | P0.16 | P0.16 is locked by SPIFI interface. |
| 64 | P5.1 | P0.17 | P0.17 is locked by SPIFI interface. |
| 65 | P5.0 | P0.18 | P0.18 is locked by SPIFI interface. |
| 107 | P5.4 | NC | The LPC4088 has a new port P5. |
| 108 | P5.3 | NC | The LPC4088 has a new port P5. |
| 109 | P5.2 | NC | The LPC4088 has a new port P5. |
| 111 | P1.16 | NC | P1.16 normally not accessed via this pin (see pin 115 instead). |
| 113 | Buffered P4.31 (CS1) | NC | CS1 can be used for external expansion in case the LPC4088 OEM board NAND flash not used. |
| 114 | P4.30 | NC | Unbuffered version of CS0 (in case the pin shall be an input and CS0 no used). |
| 115 | P1.16 | NC | P1.16 carries I2S-MCLK signals for I2S (audio) applications. This signal can be used by the OEM Base board. |
| 127 | 16-bit: P4.28<br>32-bit: NC | P4.28 | P4.28 carries BLS2, which is a critical signal on 32-bit boards. On LPC4088 boards this (unbuffered) signal is not available off-board. Only the buffers signal is available. |
| 128 | 16-bit: P4.29<br>32-bit: NC | P4.29 | P4.29 carries BLS3, which is a critical signal on 32-bit boards. On LPC4088 boards this (unbuffered) signal is not available off-board. Only the buffers signal is available. |
| 132 | P2.14 via buffer (CS2) | P2.29 via buffer (DQM1) | Expansion with dynamic memory bus not supported. DQM1 signal replaced by buffered CS2 for static memory bus expansion. |

| | | | |
|---|---|---|---|
| 134 | P4.30 via buffer (CS0) | P2.28 via buffer (DQM0) | Expansion with dynamic memory bus not supported. DQM1 signal replaced by buffered CS0 for static memory bus expansion. |
| 136 | P4.29 via buffer (BLS3) | P2.16 via buffer (CAS) | Expansion with dynamic memory bus not supported. CAS signal replaced by buffered BLS3 for static memory bus expansion (when 32-bit bus used). |
| 138 | P4.28 via buffer (BLS2) | P2.17 via buffer (RAS) | Expansion with dynamic memory bus not supported. RAS signal replaced by buffered BLS2 for static memory bus expansion (when 32-bit bus used). |
| 163 | P2.15 via buffer (CS3) | DBUS_EN | There is no need to control the databus buffers on the LPC4088 OEM board. Instead the CS3 signal is available for external static memory region expansion. |
| 164 | ABUF_EN (but connected to GND on OEM board) | ABUF_EN | There is no need to control the address buffers on the LPC4088 OEM board. They are always enabled. |

## 3.8 Things to Note

### 3.8.1 Warm Reset and Ethernet PHY

The RSTOUT/RESET_OUT signal from the LPC4088 controls the reset input to the Ethernet PHY (LAN8720). If the reset condition for the LPC4088 is internal, for example a watchdog reset or forced reset via CMSIS NVIC_SystemReset() function call, the length of the reset pulse on RSTOUT/RESET_OUT is very short - as low as 1.5 us. This is too short for the LAN8720 to get a proper reset.

If warm resets are implemented as part of the application, then external hardware must be added that supports triggering the RESET_IN signal to get a proper reset signal for the Ethernet PHY (LAN8720). Whenever a warm reset event occurs, the RESET_IN signal must be pulled low via for example a GPIO. The reset generator on the LPC4088 OEM board will then generate a proper length reset signal.

# 4 OEM Base Board Design

This chapter contains information about the peripherals and general design of the *OEM Base Board* and how to set the different jumpers on the board. The schematic can be downloaded in pdf format from the support page, and is recommended to have printed out while reading this chapter.

Section naming begins with *SPx*, which is short for *Schematic Page x*.

The picture below gives an overview of the *OEM Base Board* design.

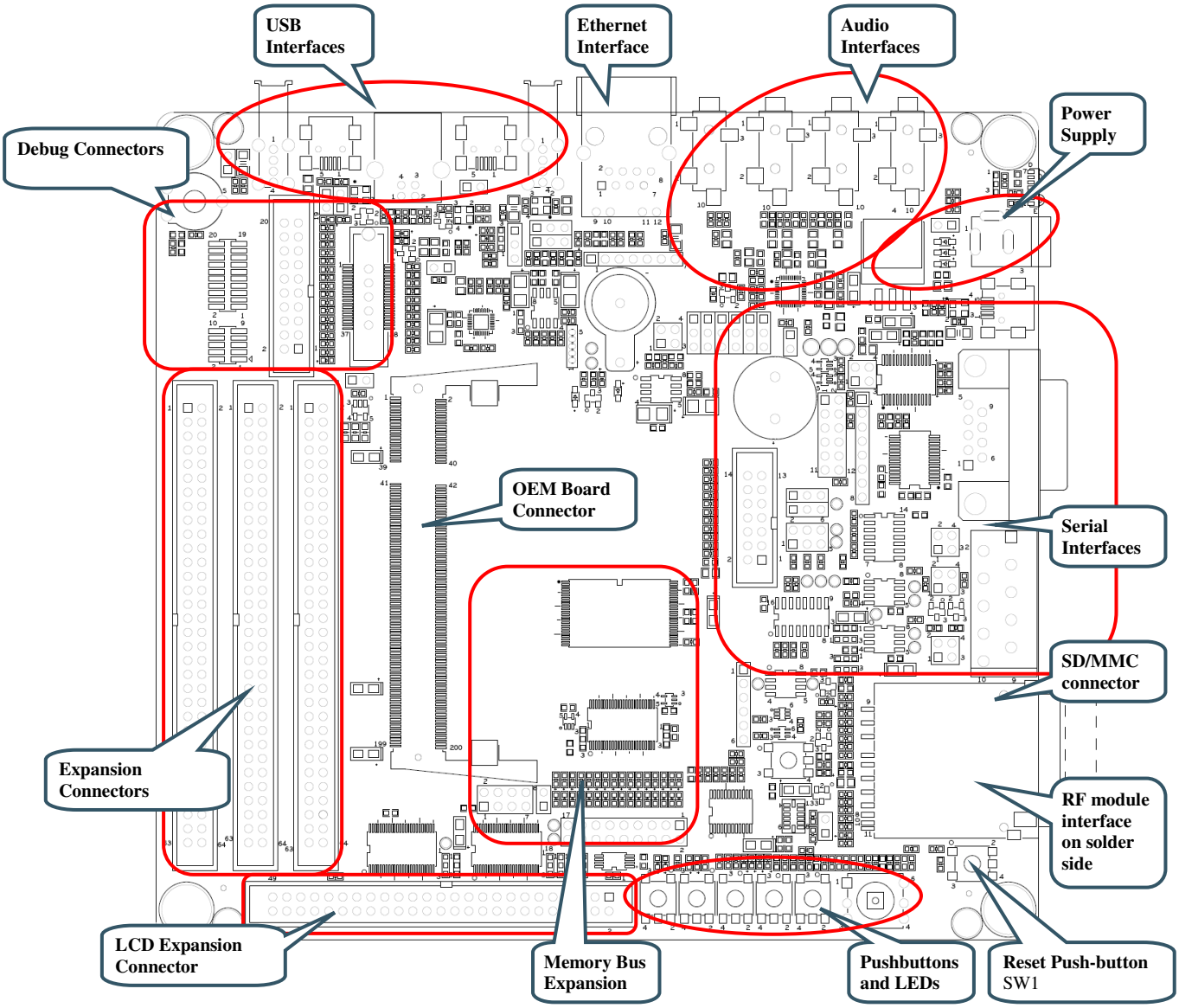


Figure 1 – OEM Base Board Overview

## 4.1 Modifications to OEM Base Board

The *OEM Base Board* has been designed to be flexible. Most options can be controlled via jumpers but some options might need soldering. Note that modifications to the board are done at own risk and void all warranties.

## 4.2 SP2: OEM Board Connector

The LPC4088 OEM board connector is a standard DDR2 SO-DIMM socket with 200 positions and 0.6mm pitch. It has 1.8V keying (which is what DDR2 stands for). The signal names are general and represent the OEM base board functionality, rather than the LPC4088 signal names. This is because the OEM base board also supports other OEM boards.

## 4.3 SP2: Current Measurements

It is possible to accurately measure current consumption of the LPC4088 OEM board. This can be very valuable when working with applications that make use of the low power modes of the LPC4088 processors. The circuit is based on the chip ZXCT1010 from Diodes/Zetex. This chip generates a voltage output proportional to the current through R2. This voltage can be measured over J2. 100mA gives a 500mV output voltage, or expressed differently, 1mV correspond to 0.2mA

It is possible to remove R1, R2 and/or R3 for measuring current with an external multimeter. Note that VCC_MAIN and VCC_BUFFERS are connected on the LPC4088 OEM board so there is no difference between these supplies. This division has been done for compatibility with other OEM boards.

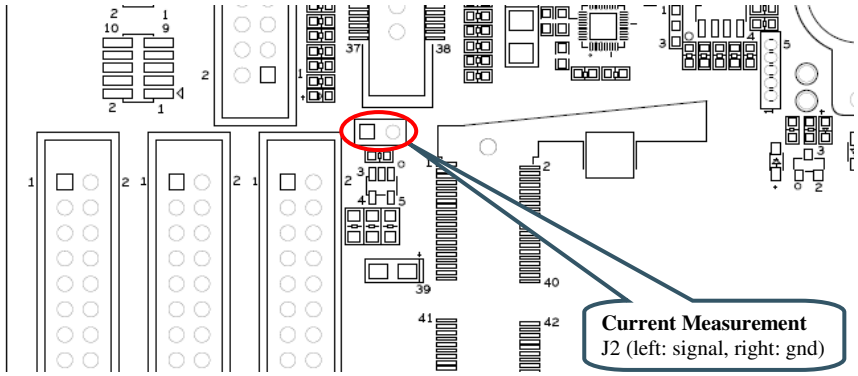


Figure 2 – Current Measurement J2

## 4.4 SP3: Expansion Connectors

All relevant OEM board signals are available for external use via three 64 pos IDC expansion connectors; J3, J4 and J5. The expansion connectors are close to the SO-DIMM connectors to minimize signal distortion.

Note that some OEM board circuits may need to be disconnected before externally used. Carefully investigate the need for this before using a signal for external expansion.

Note that J4 has gathered all needed signals for expanding the memory bus (16-bit bus expansion). J4 is the expansion connector closest to the board edge.

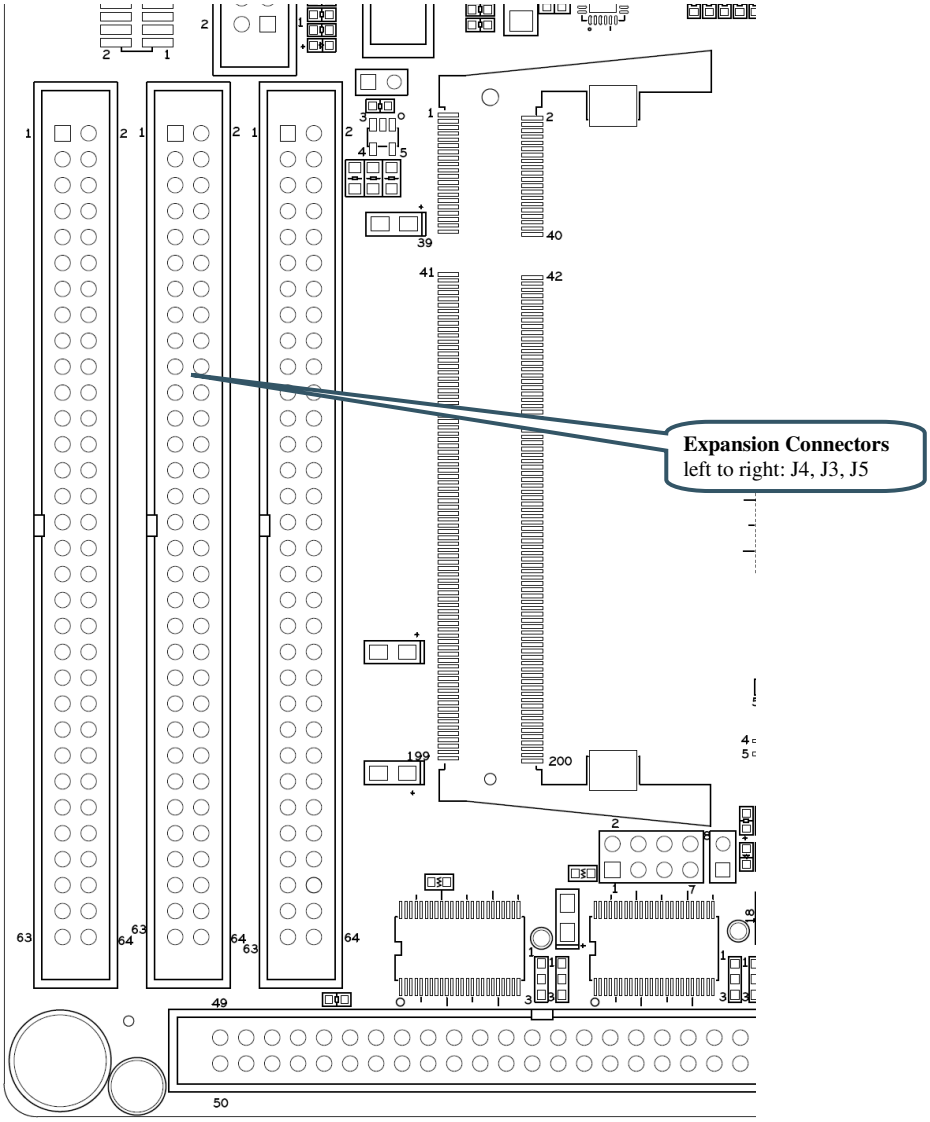


Figure 3 – Expansion Connectors J3, J4, J5

## 4.5 SP4: External Memory Bus

This part of the OEM Base Board demonstrates how the external memory bus can be used for expansion of custom circuits. Two different devices are connected to the memory bus; a 16-bit parallel NOR flash and a 16-bit register.

In order to be universal between 16- and 32-bit databus width OEM Boards, only the lower 16 bits are connected.

The 16-bit parallel NOR flash is enabled when JP1 is inserted, see picture below for guidance where to find JP1 on the OEM Base Board. Note that the signal name is cryptic since the OEM Base Board is compatible with many different OEM Board. For the LPC4088 OEM Board, the signal BDQM0-BCSY is actually signal BCS0. This means that the NOR flash is accessible in memory region: 0x8000 0000 - 0x83FF FFFF.

Also, a 16-bit register is connected to the external memory bus. The 16 bits in the register directly drives 16 LEDs (a high signal light a LED). The signals are also available on an expansion connector (J6). It can for example connect to a logic analyzer, for high-bandwidth logging. The upper and lower 8 bits are individually writeable. Signals BBLS0/BBLS1 controls the lower and upper 8 bits, respectively. Since the OEM Base Board is universal and supports many different OEM Boards, the chip select signal is either signal BDQM1-BCSX or GPIO69. For the LPC4088 OEM Board, the signal BDQM1-

BCSX is actually signal BCS2. This means that the NOR flash is accessible in memory region: 0x9800 0000 - 0x9BFF FFFF. No jumper in JP2 is needed when working with the LPC4088 OEM Board.

SJ12 shall be in default position (pad 1-2 shorted) to let BCS2 control chip select of the 16-bit register.

SJ1 controls the output enable of the register. By default it is grounded (pad 1-2 is shorted) and hence the register drives the LEDs and expansion connector, J6.

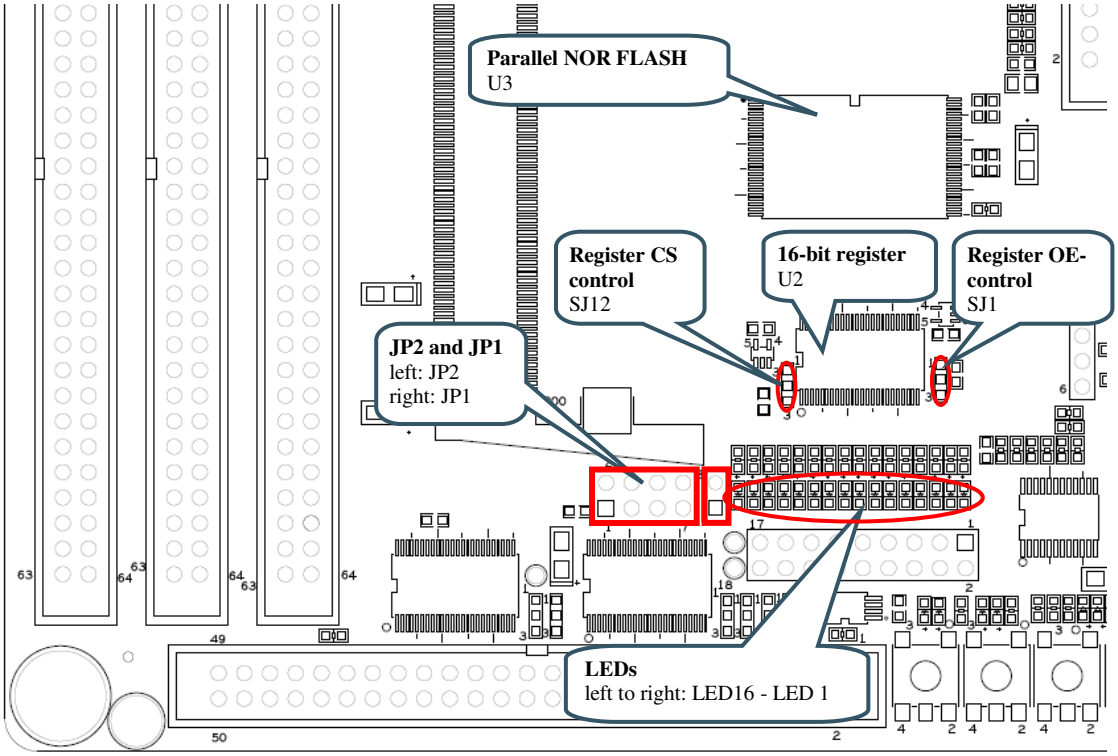


Figure 4 – External Memory Bus Circuit

## 4.6 SP5: Debug Interfaces

The multiple debug interfaces can look complex, but that is just because the board supports many different OEM Boards. The connectors are:

- J7 – this is the new and smaller footprint standard ARM debug connector. It has 2x5 pins in 50 mil pitch. The connector supports both the SWD and JTAG interfaces. Note that not all, and in particular older, JTAG debug probes do not support the SWD interface standard. Note where pin 1 is found (see picture below) for this connector.
- J8 – this is the old and big footprint standard ARM debug connector. It has 2x10 pins in 100 mil pitch. The connector supports both the SWD and JTAG interfaces. Note that not all, and in particular older, JTAG debug probes do not support the SWD interface.
- J9 – this is the old and big footprint 38 pin Mictor connector for ETM trace for the LPC2478. This connector is not mounted. It is not used when working with the LPC4088 OEM board. The connector can be soldered to the board if needed. The connector can be bought from Tyco Electronics Amp and is a 38-way receptacle Mictor connector, 0.025" pitch, part number: 767054-1 or 2-5767004-2 (RoHS compliant).
- J10 – this is the new and smaller footprint standard ARM Cortex-M3 connector for trace. It carries the trace signals as well as the debug signals found on J7.
  Note where pin 1 is found (see picture below) for this connector.

When working with the LPC4088 OEM Board, J7 is typically used. If an older and big footprint JTAG debug pod is used, J8 can alternatively be used.

If trace is also used, J10 shall be used. Note that this requires an advanced JTAG probe.

JP3 and JP4 are not used for debug purposes when working with the LPC4088 OEM Board.

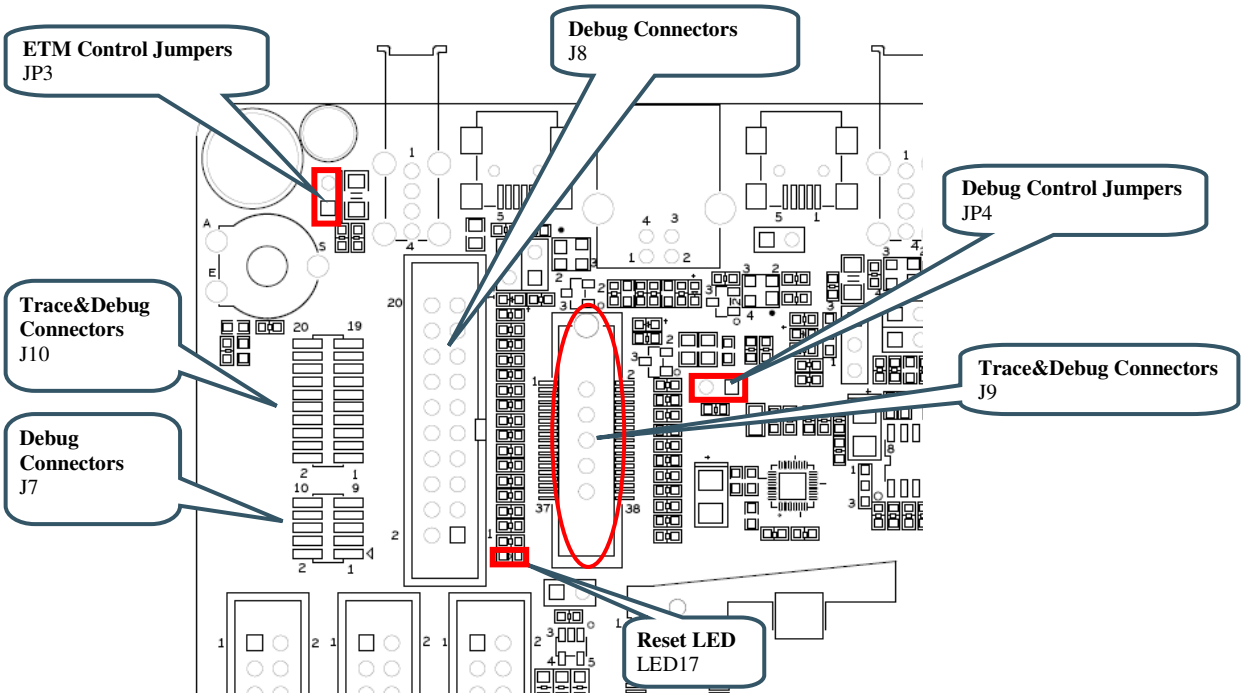


Figure 5 – Debug Interfaces

## 4.7 SP6: Ethernet Interface

The board has an Ethernet interface, J11, which is a RJ45 connector with integrated magnetics. There is also provision on the board for connecting a PoE interface. All signals can be accessed via expansion pads, J12. Five 0 ohm resistors have to be removed in that case for isolating J11 from the new connector (this is because J11 is not capable of handling a PoE interface so a new RJ45 connector must added). See picture below for where to find the relevant components on the board.

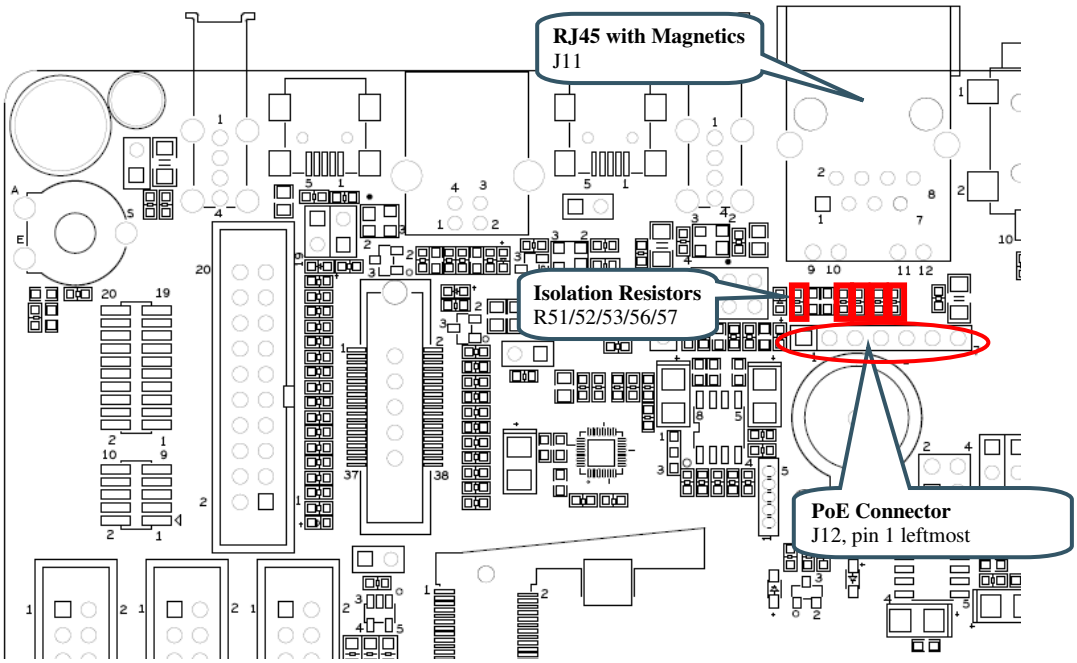


Figure 6 – Debug Interfaces

PoE modules that can be used for testing can for example be found at http://www.silvertel.com/poe_products.htm. Select a version delivering +5V with enough current capability for the specific application in mind. For example, using USB Host with power hungry external devices will require more current. In most situations a 9-10W module will be sufficient.

Besides the PoE module, a RJ45 capable of handling PoE is also needed.

## 4.8 SP6: SD/MMC Memory Card Interface

The board has a SD/MMC memory card interface, J13. Supply voltage to the external memory card is controlled via Q1. The Card Detection (CD) and Write Protect (WP) signals are connected to the I2C port expander on schematic page 7. There is also visual indication of supply voltage and the CD and WP signals via LEDs, see picture below where to find the LEDs on the board. Note that the Write Protect-LED is actually inverted. It is on when the memory card is not write protected and off when it is write protected.

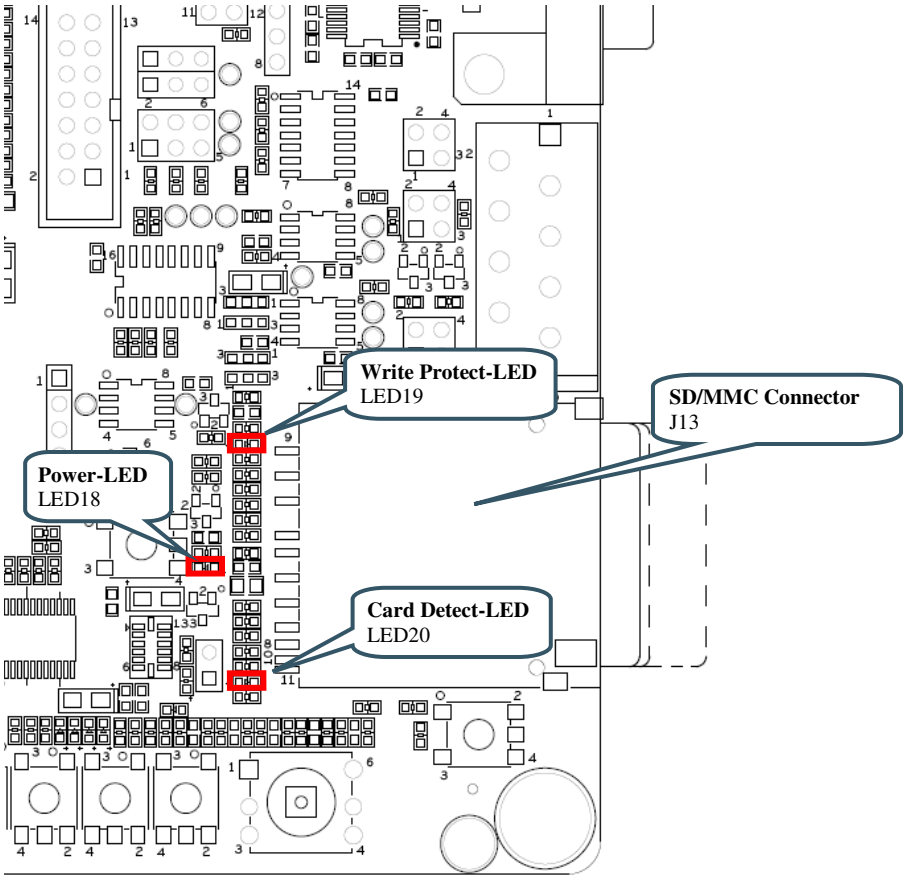


Figure 7 – SD/MMC Memory Card Interface

## 4.9 SP6: VBAT/ALARM Handling

The board can power the VBAT input supply (to the OEM board) from two different sources:

- The +3.3V power supply, via D1 (when board is normally powered).
- A 3V Lithium CR1025 size coin battery, via D2. Note that battery is not included.

See the LPC4088 datasheet for details about VBAT voltage range.

The ALARM signal control LED21. Note that LED21 will consume a lot of current from the battery and/or super-capacitor. Restrict on/high time to conserve energy.

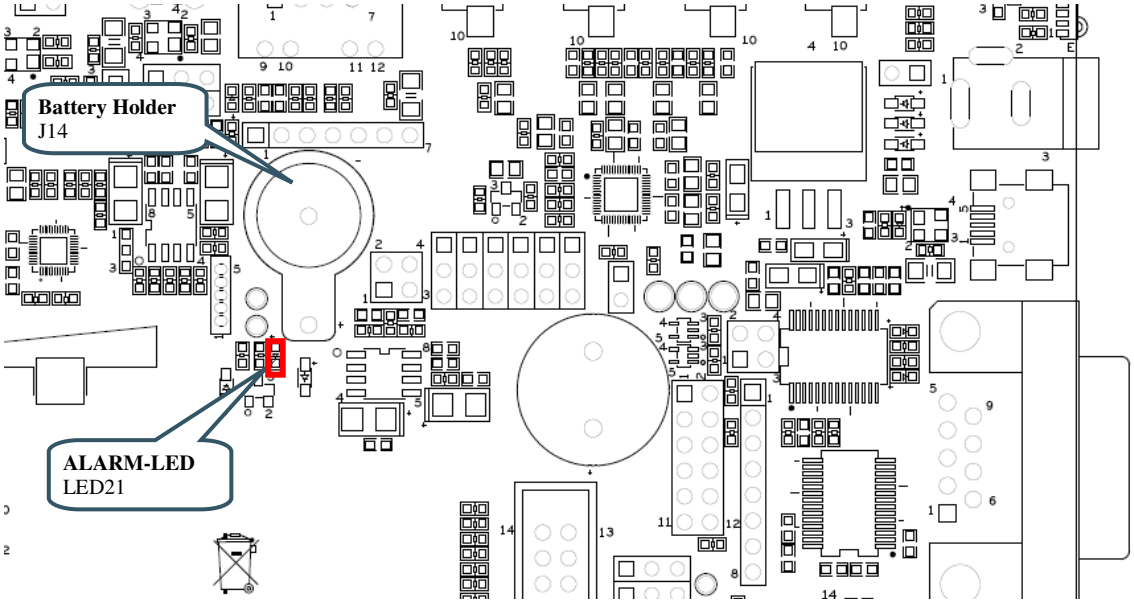


Figure 8 – VBAT and ALARM circuit

## 4.10 SP7: I2C Peripherals

There are several I2C peripherals on the board. See picture below for locating the different components on the board. The I2C addresses for the individual components are given in the schematic.

- Configuration E2PROM, 64kbit. This chip contains version information about the OEM Base Board.
- LM75 Temperature sensor.
- 3-axis Accelerometer (MMA7455). Note that the two interrupt outputs are not connected but available on JP5.
- Port expander (PCA9532) with 8 LEDs and 4 pushbuttons. The Card Detect and Write Protect signals from the SD/MMC memory card connector are also connected to this chip. LED22/23 are positioned above SW2, LED24/25 are positioned above SW3, LED26/27 are positioned above SW4 and LED28/29 are positioned above SW5.

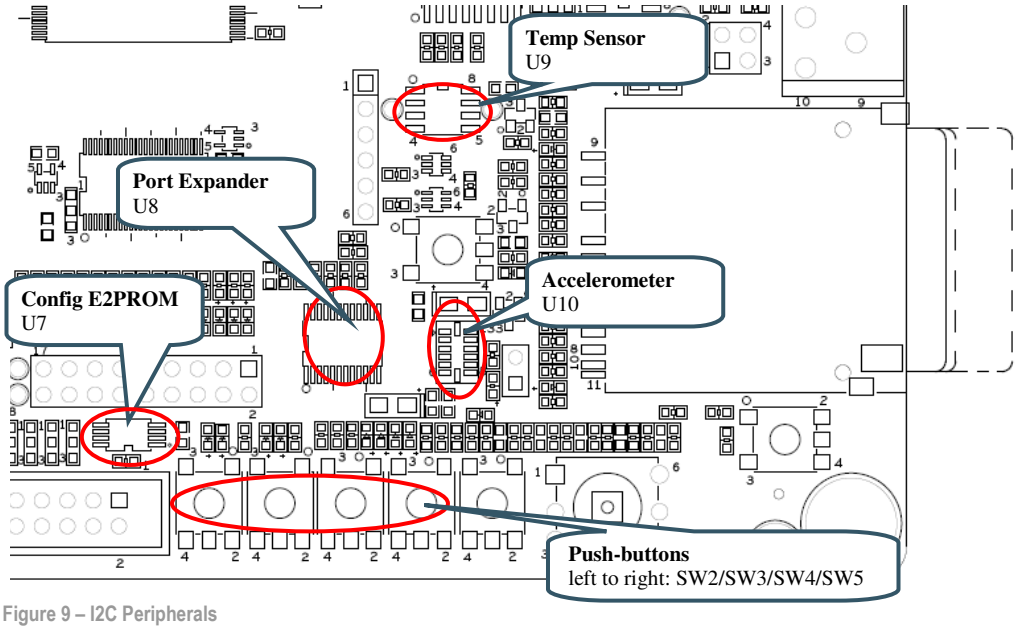


Figure 9 – I2C Peripherals

| Signals | LPC4088 |
|---|---|
| I2C-SDA | P0.27 |
| I2C-SCL | P0.28 |

## 4.11 SP8: Analog Input

The board contains a trimming potentiometer (R94) for manually generating an adjustable voltage (between GND and VREF). See picture below where to locate the trimming potentiometer on the board. The table list which pin the adjustable voltage is connected to.

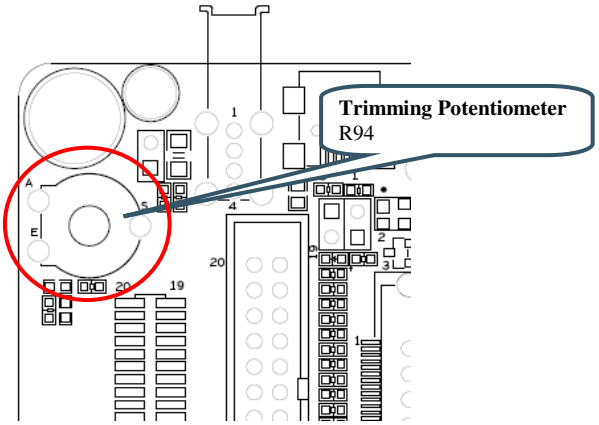


Figure 10 – Analog Input

| Signals | LPC4088 |
|---|---|
| GPIO39_AIN2 | P0.25 |

## 4.12 SP8: Digital IO

There is a push-button (SW6) that is connected to a signal that enable the ISP-mode after reset on the OEM Board. For the LPC4088 this is pin P2.10. If this pin is sampled low after reset, the ISP-mode for the LPC4088 is entered. LED30 is positioned above SW6 and will light when SW6 is pressed. It is also possible to control LED30 as an output from the OEM Board without damaging the output driver when SW6 is pressed. R110 limits the current.

There is also a 5-key joystick that directly connects to five general purpose input/output pins. See picture below for locating SW6 and SW7.

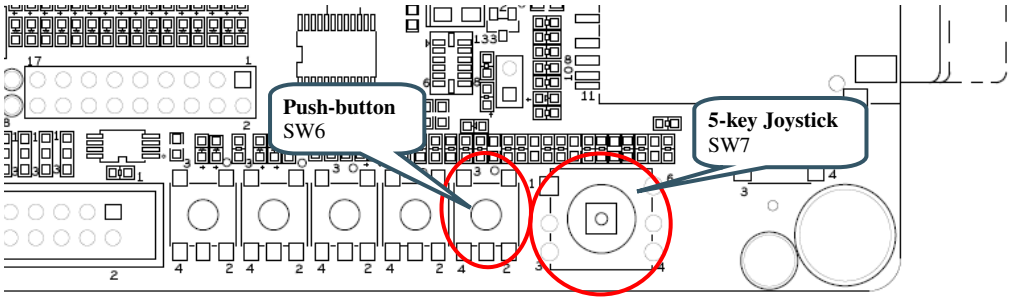


Figure 11 – Digital IO

| Signals | LPC4088 |
|---|---|
| GPIO_10 | P2.10 |
| GPIO_73 | P2.22 |
| GPIO_74 | P2.23 |
| GPIO_75 | P2.25 |
| GPIO_76 | P2.26 |
| GPIO_77 | P2.26 |

## 4.13 SP8: Serial Expansion Connector

The *Serial Expansion Connector* is a standardized serial interface connector that is included on many boards from Embedded Artists, including the OEM Base Board. The purpose is to provide a simple expansion connector for smaller expansion modules. Such modules are typically sensors of different kinds and communication modules, but can also be smaller displays.

The connector contains 14 pins that support SPI, UART and I2C communication. Four additional pins exist for specific functionality, like module reset, interrupt pins, analog signals and pwm signals. Power (3.3V) is also provided. Maximum current consumption of the external module is 250mA. All signals are protected with 470 ohm series resistors to minimize current in case of shorts to ground, +3.3V, or similar.

Usage of the different signals is specific for each module connected. All signals can be configured as either main function or alternatively as a general purpose input/output signal (GPIO). The picture below show where the connector can be found and the table lists which pins are connected. The application program has the responsibility to program the individual pins to correct state/function.

Note that the UART channel is not directly connected to a UART channel on the LPC4088. It is multiplexed with other UART channels, see section 4.15 for details. Also note that the *Serial Expansion Connector* and the RF-module (see section 4.14 ) share the same UART channel. Once the RF module is soldered, the *Serial Expansion Connector* cannot be used for UART communication.