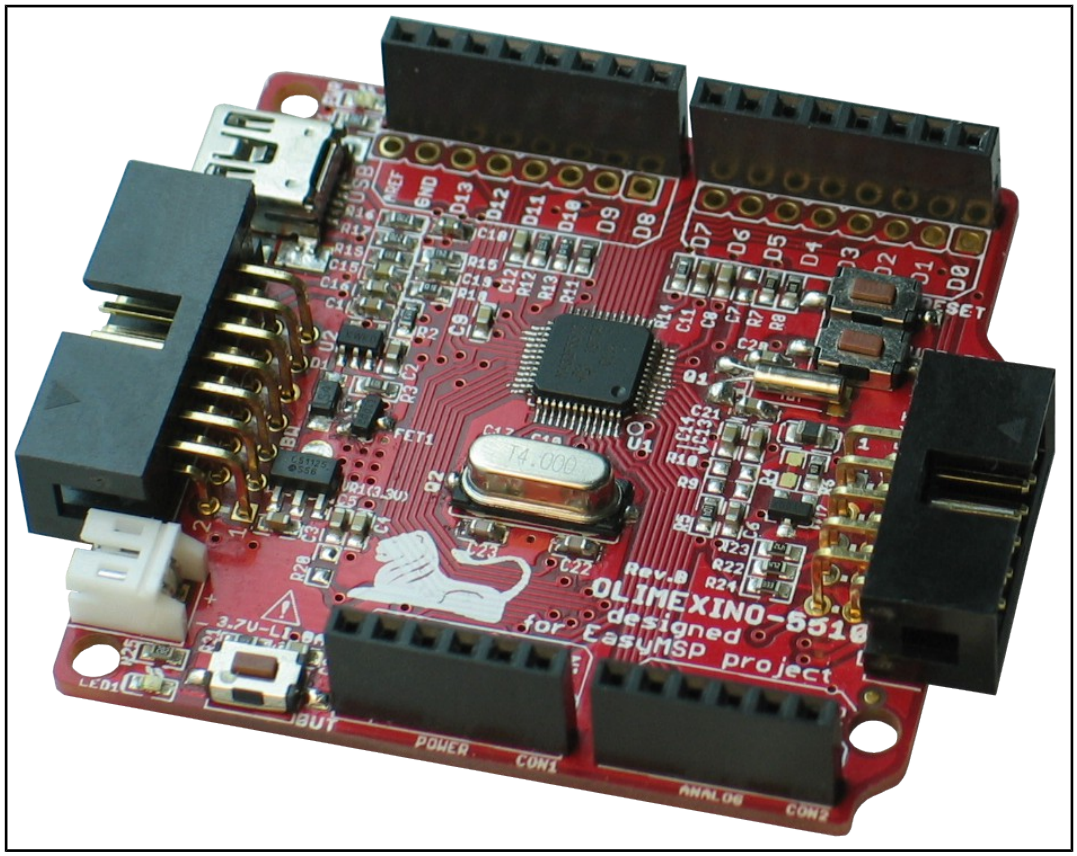


OLIMEXINO-5510
Development board

USER'S MANUAL

Document revision D, July 2015
Designed by OLIMEX Ltd, 2012

lead-free

All boards produced by Olimex LTD are ROHS compliant

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It is possible that the pictures in this manual differ from the latest revision of the board.

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CHAPTER 1: OVERVIEW

1. Introduction to the chapter

Thank you for choosing the OLIMEXINO-5510 development board from Olimex! This document provides a user's guide for the Olimex OLIMEXINO-5510 board. As an overview, this chapter gives the scope of this document and lists the board's features. The document's organization is then detailed.

The OLIMEXINO-5510 development board enables code development of applications running on the microcontroller MSP430F5510, manufactured by Texas Instruments.

1.1 Features

Some of the main board features are listed below:

- MCU: MSP430F5510 with 32K Bytes Program Flash, 4K Bytes RAM, 25Mhz
- Power supply circuit
- Power-on led
- Li-Po battery connector
- Li-Po battery recharge circuit
- RTC (Real-time clock) quartz crystal
- UEXT connector
- User LED
- SBW interface
- User button, boot button and RESET button
- Reset button
- FR-4, 1.5 mm, soldermask, component print
- Dimensions: 53.3mm x 55.9mm (2.1" x 2.2")

1.2 Target market and purpose of the board

OLIMEXINO-5510 is intended to work with Energia - an Arduino-like IDE for MSP430. The community is working on adding full support for Energia. At the time of writing this manual such support isn't fully added but it is on the way. When such support is implemented there will be software examples below in Energia format.

OLIMEXINO-5510 was specially designed for the EasyMSP project which is created by Matthew Burmeister (a.k.a. MattTheGeek from 43oh.com). Matt did amazing work by creating Arduino-like language and commands to compile with MSP430 hardware just adding these in header files, so they compile with MSPGCC. However, personal problems restrained Matthew to finish the project he started. That is why Energia is the now default and recommended development environment.

The target market are the MSP430 fans and electronics beginners. People with better understanding of software than hardware. Arduino platform fans.

1.3 Organization

Each section in this document covers a separate topic, organized as follow:

- Chapter 1 is an overview of the board usage and features
- Chapter 2 provides a guide for quickly setting up the board and software notes
- Chapter 3 contains the general board diagram and layout
- Chapter 4 describes the component that is the heart of the board: the OLIMEXINO-5510 microcontroller
- Chapter 5 is an explanation of the control circuitry associated with the microcontroller to reset. Also shows the clocks on the board
- Chapter 6 covers the connector pinout, peripherals and jumper description
- Chapter 7 shows the memory map
- Chapter 8 provides the schematics
- Chapter 9 contains the revision history, useful links and support information

CHAPTER 2: SETTING UP THE OLIMEXINO-5510 BOARD

2. Introduction to the chapter

This section helps you set up the OLIMEXINO-5510 development board for the first time. Please consider first the electrostatic warning to avoid damaging the board, then discover the hardware and software required to operate the board.

The procedure to power up the board is given, and a description of the default board behavior is detailed.

2.1 Electrostatic warning

OLIMEXINO-5510 is shipped in a protective anti-static package. The board must not be exposed to high electrostatic potentials. A grounding strap or similar protective device should be worn when handling the board. Avoid touching the component pins or any other metallic element.

2.2 Hardware requirements

In order to set up the OLIMEXINO-5510 optimally, the following items are required:

1) mini USB cable for uploading a binary using the bootloader

2) JTAG/SBW (Spy-Bi-Wire) MSP430 compatible programmer – for custom programming

We offer three low-cost products capable of programming the board (of course any JTAG/SBW-compatible programmer you might already own would do the job):

MSP430-JTAG-ISO-MK2 – our best MSP430 programmer, featuring LCD display, SD card and stand-alone mode of programming: https://www.olimex.com/Products/MSP430/JTAG/MSP430-JTAG-ISO-MK2/

MSP430-JTAG-TINY-V2 – standalone programmer: https://www.olimex.com/Products/MSP430/JTAG/MSP430-JTAG-TINY-V2/

Notice our MSP programmers work with a free flash software we distribute and are compatible with all IDEs based on the original Texas Instruments MSP430.dll.

Additional components and extension boards (not required for basic operation!):

- 3.7V lithium-polymer battery

You gain mobility and back-up. The battery can be recharged when plugged to OLIMEXINO-5510 because of the built-in charger circuit (which also has the option to be disconnected via jumper).

Our offer is: https://www.olimex.com/Products/Power/BATTERY-LIPO1400mAh/.

- Shields

Some of the shields we sell for our Arduino boards can be found here:

https://www.olimex.com/Products/Duino/Shields/

- UEXT expansion boards

All OLIMEX boards which names start with MOD, are compatible with the UEXT interface. Notice that there is multiplexing between the Arduino platform connector (for the shields) and the UEXT. You can't use two devices with SPI communication at the same time.

2.3 Powering the board and operating modes

The board is powered either via the mini USB or via the 3.7V_LI_BAT connector or via the SBW interface.

The board can be programmed in three ways:

1) as a general purpose board via the SBW.
2) by the BSL (BootStrap Loader) bootloder by MSP430

When powered the red power LED should turn on. By default the green LED near the battery connector should start blinking if used in debugger/general mode.

To enter BSL mode hold USB_BSL and power the board. Or while the board is powered hold USB_BSL down then press RESET and then release USB_BSL. If the board is started in BSL mode the green LED should remain off.

2.4 Prebuilt software and bootloader

The prebuilt software is a bootloader and a simple LEDs and buttons test. When you power the board initially all LEDs will be on. If you press and hold the B1 button LED2 should start blinking. If you press and hold WAKE_UP button LED1 should start blinking. Upon releasing the buttons the LEDs should return to their initial “always on” state.

Note that you can compile binaries (suitable to upload via the bootloader) using various software products. People typically use Code Composer Studio; IAR Embedded Workbench for MSP430; Rowley CrossWorks for MSP430.

2.5 EasyMSP and Energia

OLIMEXINO-5510 is intended to work with Energia - an Arduino-like IDE for MSP430. The community is working on adding full support for Energia. At the time of writing this manual such support isn't fully added but it is on the way. When such support is implemented there will be software examples below in Energia format.

The Energia web site and repository may be found at the following web addresses:

http://energia.github.com/Energia/ and https://github.com/energia/Energia/

OLIMEXINO-5510 was specially designed for the EasyMSP project which is created by Matthew Burmeister (a.k.a. MattTheGeek from 43oh.com). Matt did amazing work by creating Arduino-like language and commands to compile with MSP430 hardware just adding these in header files, so they compile with MSPGCC. However, personal problems restrained Matthew to finish the project he started. That is why Energia is the now default and recommended development environment.

EasyMSP community is at 43oh.com forum http://www.43oh.com/forum/viewforum.php?f=34.

The project is hosted at http://code.google.com/p/easymsp/.

When we learned about EasyMSP the first idea was to create custom open hardware board which to work with EasyMSP. So we contacted Matt and asked him if he wants custom board build for his project. This is how OLIMEXINO-5510 was born.

So if you want to develop some hand-held or battery powered devices with USB connection to PC OLIMEXINO-5510 is the low cost solution for you.

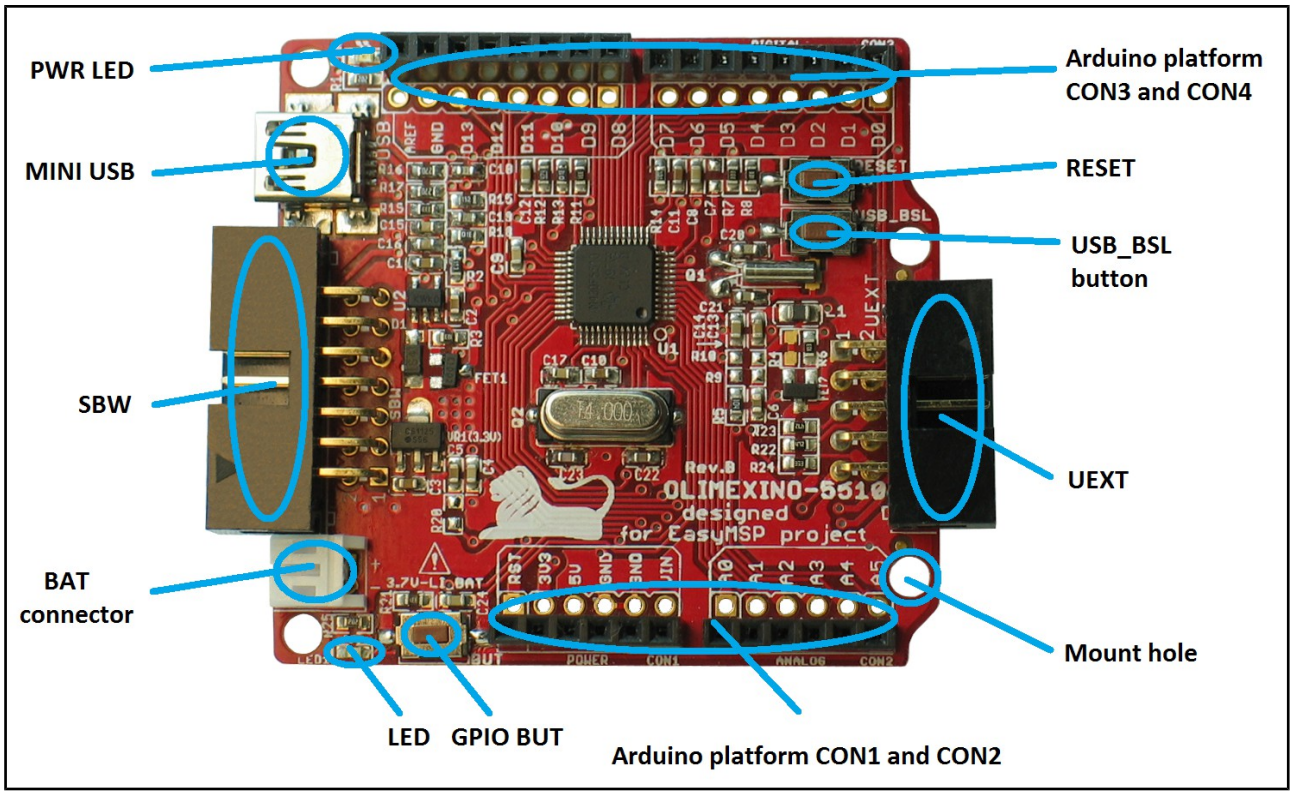
The software for the boards is released under General Purpose License.

CHAPTER 3: OLIMEXINO-5510 BOARD DESCRIPTION

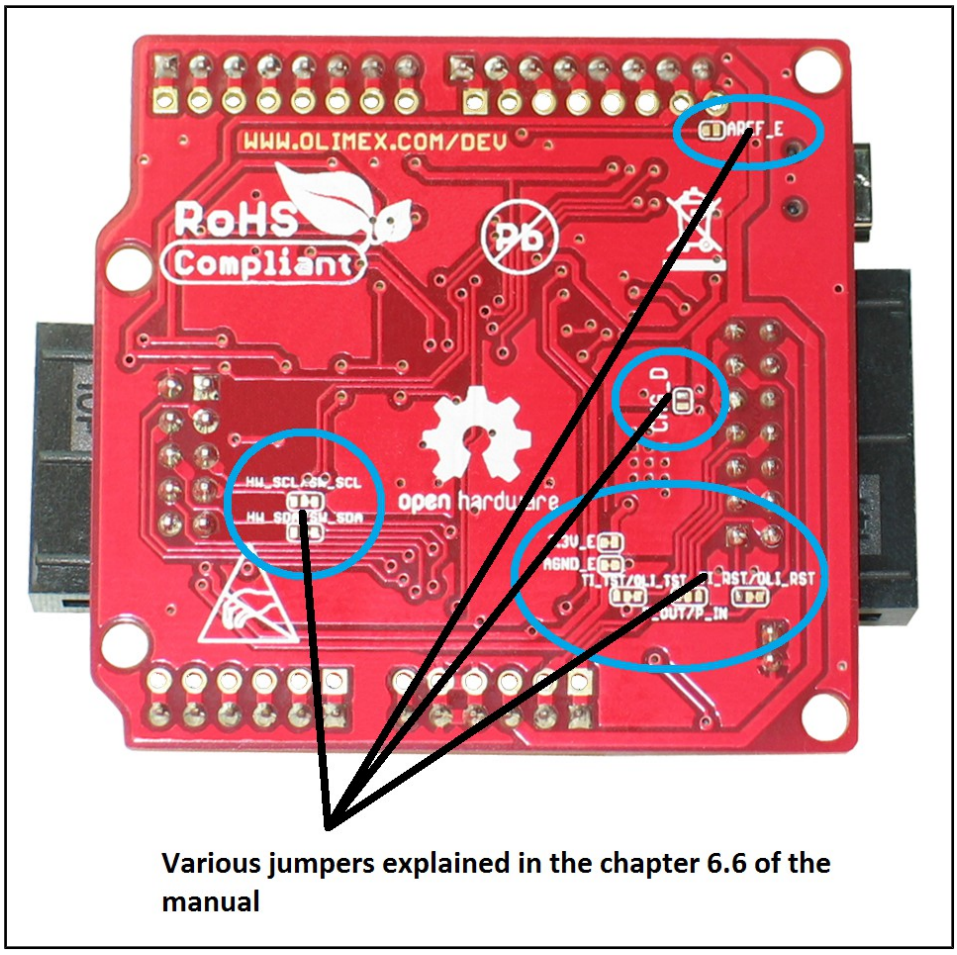
3. Introduction to the chapter

Here you get acquainted with the main parts of the board. Note the names used on the board might differ from the names used below to describe them. For the actual names check the OLIMEXINO-5510 board itself.

3.1 Layout (top view)



3.2 Layout (bottom view)



Various jumpers explained in the chapter 6.6 of the manual

CHAPTER 4: THE MSP430F5510 MICROCONTROLLER

4. Introduction to the chapter

In this chapter is located the information about the heart of OLIMEXINO-5510 – its microcontroller MSP430F5510. The information is a modified version of the datasheet provided by its manufacturers.

4.1 The microcontroller

■ Ultra-Low Power Consumption

- Active Mode (AM)
- All System Clocks Active
- 195 µA/MHz at 8 MHz, 3 V, Flash Program Execution (Typical)
- 115 µA/MHz at 8 MHz, 3 V, RAM Program Execution (Typical)

- Standby Mode (LPM3)
  - Real Time Clock With Crystal, Watchdog, and Supply Supervisor Operational, Full RAM Retention, Fast Wake-Up: 1.9 µA at 2.2 V, 2.1 µA at 3 V (Typical)
  - -Low-Power Oscillator (VLO), General-Purpose Counter, Watchdog, and Supply Supervisor Operational, Full RAM Retention, Fast Wake-Up: 1.4 µA at 3 V (Typical)
- Off Mode (LPM4)
  - Full RAM Retention, Supply Supervisor Operational, Fast Wake-Up: 1.1 µA at 3 V (Typical)
  - Shutdown Mode (LPM4.5) 0.18 µA at 3 V (Typical)

■ Wake-Up From Standby in Less Than 5 µs

■ 16-Bit RISC Architecture, Extended Memory, Up to 25-MHz System Clock

■ Flexible Power Management System

- Fully Integrated LDO With Programmable Regulated Core Supply Voltage
- Supply Voltage Supervision, Monitoring, and Brownout

■ Unified Clock System

- FLL Control Loop for Frequency Stabilization
- Low-Power Low-Frequency Internal Clock Source (VLO)
- Low-Frequency Trimmed Internal Reference Source (REFO)
- 32-kHz Watch Crystals (XT1)
- High-Frequency Crystals up to 32 MHz (XT2)

■ 16-Bit Timer TA0, Timer_A With Five Capture/Compare Registers

■ 16-Bit Timer TA1, Timer_A With Three Capture/Compare Registers

■ 16-Bit Timer TA2, Timer_A With Three Capture/Compare Registers

■ 16-Bit Timer TB0, Timer_B With Seven Capture/Compare Shadow Registers

■ Two Universal Serial Communication Interfaces

- USCI_A0 and USCI_A1 Each Supporting:
    - Enhanced UART Supporting Auto-Baudrate Detection
    - IrDA Encoder and Decoder
    - Synchronous SPI
- USCI_B0 and USCI_B1 Each Supporting:
    - I2CTM
    - Synchronous SPI

■ Full-Speed Universal Serial Bus (USB)
■ Integrated USB-PHY
■ Integrated 3.3-V/1.8-V USB Power System
■ Integrated USB-PLL
■ Eight Input, Eight Output Endpoints
■ 10-Bit Analog-to-Digital (A/D) Converter With Window Comparator
■ Comparator
■ Hardware Multiplier Supporting 32-Bit Operations
■ Serial Onboard Programming, No External Programming Voltage Needed
■ Three Channel Internal DMA
■ Basic Timer With Real Time Clock Feature

For comprehensive information on the microcontroller visit the Texas Instruments' web page for a datasheet.

At the moment of writing the microcontroller datasheet can be found at the following link:
http://www.ti.com/lit/ds/symlink/msp430f5510.pdf

CHAPTER 5: CONTROL CIRCUITY

5. Introduction to the chapter

Here you can find information about reset circuit and quartz crystals locations, the power supply circuit is discussed.

5.1 Reset

OLIMEXINO-5510's reset circuit includes R7 (33Ω), R8 (330Ω), and a RESET button.

5.2 Clocks

Q1 – 32 768 MHz quartz crystal on pins 8 and 9 of the F5510 allowing RTC(Real-Time Clock).

Q2 – 4 MHz quartz crystal is connected to pins 45 and 46 of the MSP430F5510 processor.

5.3 Power supply circuit

The power supply circuit of OLIMEXINO-5510 allows powering via two sources – from the miniUSB (the device will draw it's required current automatically, however ensure the USB port is standard compatible and can provide at least 1A of current) or from the Li-Po connector if you have 3.7V battery.

If you have both connected the USB power will charge the battery (if the battery is not full).

CHAPTER 6: CONNECTORS AND PINOUT

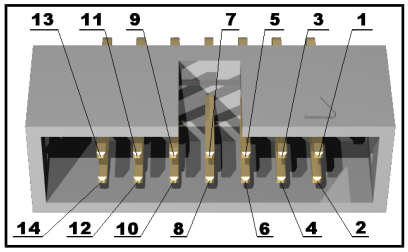
6. Introduction to the chapter

In this chapter are presented the connectors that can be found on the board all together with their pinout and notes about them. Jumpers functions are described. Notes and info on specific peripherals are presented. Notes regarding the interfaces are given.

6.1 SBW (Spy-Bi-Wire) debug connector

The SBW interface is used to program and debug the board. It is also known as “2-wire JTAG”. “NC” stands for “Not Connected”.

SBW interface			
Pin #	**Signal Name**	**Pin #**	**Signal Name**
1	NC/TI_RST*	**8**	OLI_TST/NC*
2	NC/P_IN**	**9**	GND
3	NC	**10**	NC
4	P_OUT/NC*	**11**	OLI_RST/NC*
5	Not connected	**12**	NC
6	Not connected	**13**	NC
7	NC/TI_TST*	**14**	NC



*The information lines can be switched via the SMD jumpers TI_RST/OLI_RST and TI_TST/OLI_TST. This might be required for different programmers. If you use Texas Instruments programmer switch them to TI_RST and TI_STS. If using Olimex programmer switch to OLI_RST and OLI_TST. By default they are in Olimex position.

**The Pin/Pout jumper declares if the board is internally powered or has to be powered externally (via SBW programmer).

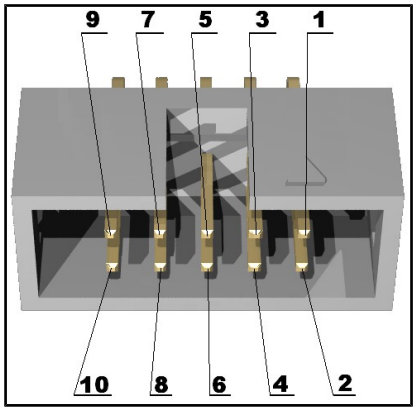
6.2 UEXT connector

OLIMEXINO-5510 board has a UEXT connector and can interface Olimex's UEXT expansion modules.

For more information on UEXT please visit:

http://www.olimex.com/dev/OTHER/UEXT.pdf

UEXT connector	
Pin #	Signal Name
1	+3.3V
2	GND
3	D1(TXD)
4	D0(RXD)
5	SW_SCL/NC*
6	SW_SDA/NC*
7	NC/D12(MISO1)*
8	NC/D11(MOSI1)*
9	D13(SCK)
10	#UEXT_CS



*Those pin signals depend on the jumpers HW_SCL/SW_SCL and HW_SDA/SW_SDA. By default the board is set in software SPI mode (SW_SCL/SW_SDA).

Notice the orientation of the cut on the connector in the picture above.

6.3 Arduino shield platform connectors

The pad names are written on the board and the names are above the corresponding pads.

Arduino shield			
POWER – CON1		ANALOG – CON2	
Pad name	[Name], Processor pin#	Pad name	[Name], Processor pin#
RST	RST, 48	A0	1
3V3	11,28	A1	2
5V	41	A2	3
GND	12, 27, 37	A3	BAT_SENSE, 4
GND	12, 27, 37	A4	AREF, 5
V_IN	-	A5	6
DIGITAL – CON3		DIGITAL – CON4	
Pad name	[Name], Processor pin#	Pad name	[Name], Processor pin#
D0	RXD, 34	D8	20
D1	TXD, 33	D9	21
D2	14	D10	#SS, 29
D3	15	D11	MOSI, 30
D4	16	D12	MISO, 31
D5	17	D13	SCK, 32
D6	18	GND	14, 18
D7	19	AREF	5

The ones with the optional [Name] attribute present are multiplexed with another connector or peripheral. In our case the signals are multiplexed with the UEXT.

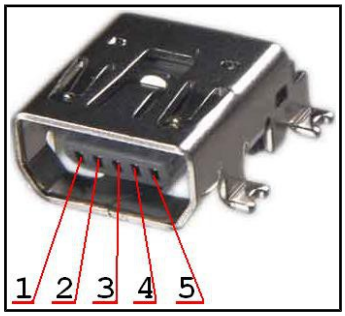
6.4 Mini USB

This connector can be used to program the board (as an alternative to using a programmer tool). Make sure to enter bootloader mode and use the mini USB to establish connection between the board and the personal computer. To enter BSL mode hold USB_BSL and power the board. Or while the board is powered hold USB_BSL down then press RESET and then release USB_BSL. If the board is started in BSL mode the green LED should remain off.

There are no drivers required. This is because the MSP430 reports itself as a Human Interface Device (HID), which has built-in Windows support. HID is a great fit for firmware updates. The only way to upload code via the USB at the moment is to use a pack of softawre tools from the official Texas Instruments web-site. The software tool to search for and download is named: “MSP430 USB Firmware Upgrade Example”.

Note that you can compile binaries (suitable to upload via the bootloader) using various software products. People typically use Code Composer Studio; IAR Embedded Workbench for MSP430; Rowley CrossWorks for MSP430.

Pin #	Signal Name
1	+5V
2	D-
3	D+
4	Not connected
5	GND



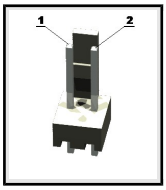
Note that this is not USB OTG (On-The-Go).

6.5 Battery connector

Please make sure you use 3.7V lithium battery. The voltage of such a battery might vary from 2.75V up to 4.2V (discharged, fully charged).

Note that the board features battery charging circuit. It will charge the battery if it's voltage drop below a certain threshold and other source of power is present. Mind that such a charging might draw considerable amount of current (especially if the battery is fully discharged). When the board has a battery connected AND USB connected simultaneously the battery would get recharged thanks to the recharge circuit.

Pin #	Signal Name
1	VBAT
2	GND



The pin names are also written on the top of the board in the base of the connector.

6.6 Jumper description

Please note that the jumpers on the board are ONLY SMD type. For setting the SMD jumpers please consider that if you feel insecure of your soldering/cutting technique it is better not to try to adjust those jumpers.

6.6.1 P_OUT/P_IN

When in position P_IN, the board gets powered by SBW debugger.
When is position P_OUT, the board gets powered by other two sources.

The default position is P_OUT.

6.6.2 3.3V_E

When open 3.3V_E the processor doesn't receive power. Processor pins 11 and 28 are disconnected from the power circuit.

The default position is closed.

6.6.3 AGND_E

When open AGND_E disables the analog ground signal.

The default position is closed.

6.6.4 CHG_D

When closed disables the battery charging circuit.

The default position is jumper open.

6.6.5 AREF_E

When open disables the AREF on the shield CON4.

The default position is open.

6.6.6 TI_TST/OLI_TST and TI_RST/OLI_RST

Note these jumpers must be moved together!

They control the TST and RST signals on the SBW interface. The TST and RST differ when using different programmers. If you are not sure how your programmer is configured and the board doesn't get programmed via SBW try the TI_TST + TI_RST option.

The default position is OLI_TST closed + OLI_RST closed.

6.6.7 HW_SCL/SW_SCL and HW_SDA/SW_SDA

Note these jumpers must be moved together!

They configure either hardware or software SPI on the UEXT.

The default position is set for software SPI – SW_SCL closed + SW_SDA closed.

6.7 Additional hardware components

The components below are mounted on OLIMEXINO-5510 but are not discussed above. They are listed here for completeness:

Reset button – used for hardware reset of the board

BUT – general purpose button

USB_BSL – used for starting the MSP430 bootstrap loader

Battery recharge circuit

Battery sense circuit on processor pin 25

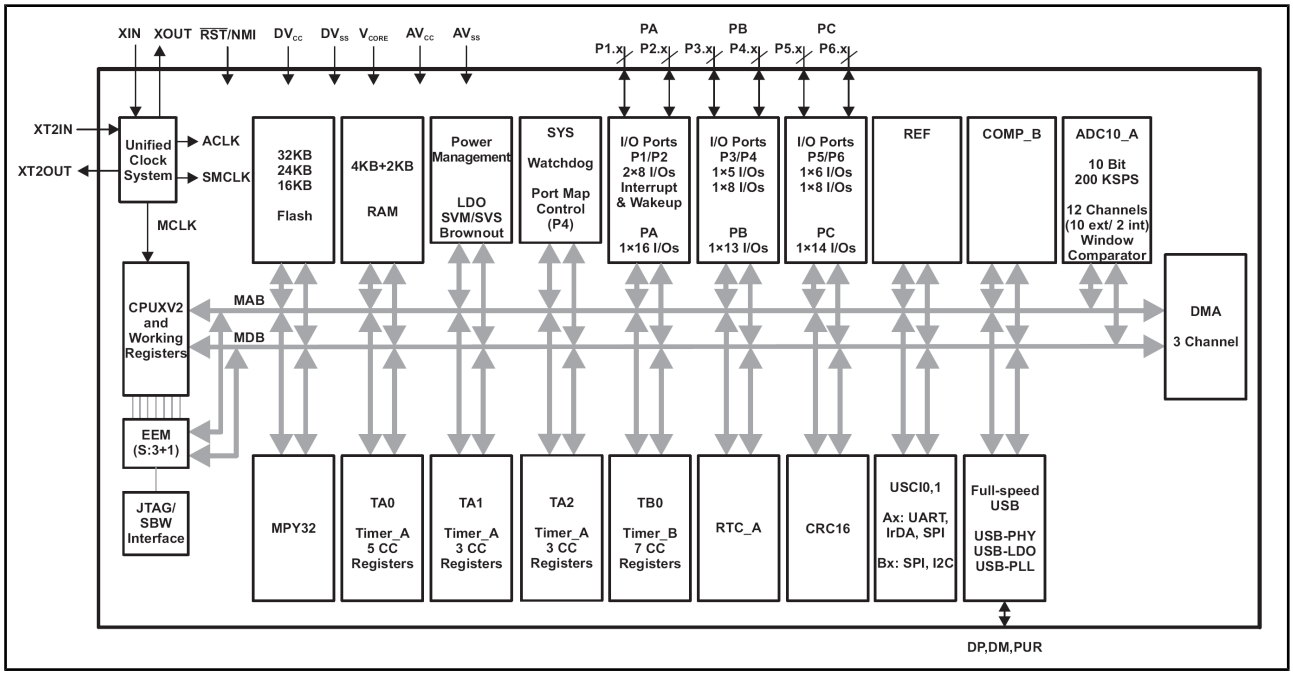
LED1 (Green) – pin 26 + Power LED (Red)

CHAPTER 7: BLOCK DIAGRAM AND MEMORY

7. Introduction to the chapter

On the next page you can find a memory map for this family of processors. It is strongly recommended to refer to the original datasheet released by NXP for one of higher quality.

7.1 Processor block diagram



The block diagram is taken from the original datasheet of MSP430F5510.

7.2 Physical memory map

This is the memory map diagram from the original datasheet of MSP430F5510. You may use it if you need to adjust the configuration file in Olimex MSP programmer software (to add the device).

		MSP430F5510 MSP430F5507 MSP430F5503
Memory (flash) Main: interrupt vector Main: code memory	Total Size	32 KB 00FFFFh–00FF80h 00FFFFh-008000h
RAM	Sector 1	2 KB 0033FFh–002C00h
	Sector 0	2 KB 002BFFh–002400h
USB RAM(2)		2 KB 0023FFh–001C00h
Information memory (flash)	Info A	128 B 0019FFh–001980h
	Info B	128 B 00197Fh–001900h
	Info C	128 B 0018FFh–001880h
	Info D	128 B 00187Fh–001800h
Bootstrap loader (BSL) memory (flash)	BSL 3	512 B 0017FFh–001600h
	BSL 2	512 B 0015FFh–001400h
	BSL 1	512 B 0013FFh–001200h
	BSL 0	512 B 0011FFh–001000h
Peripherals	Size	4 KB 000FFFh–0h

CHAPTER 8: SCHEMATICS

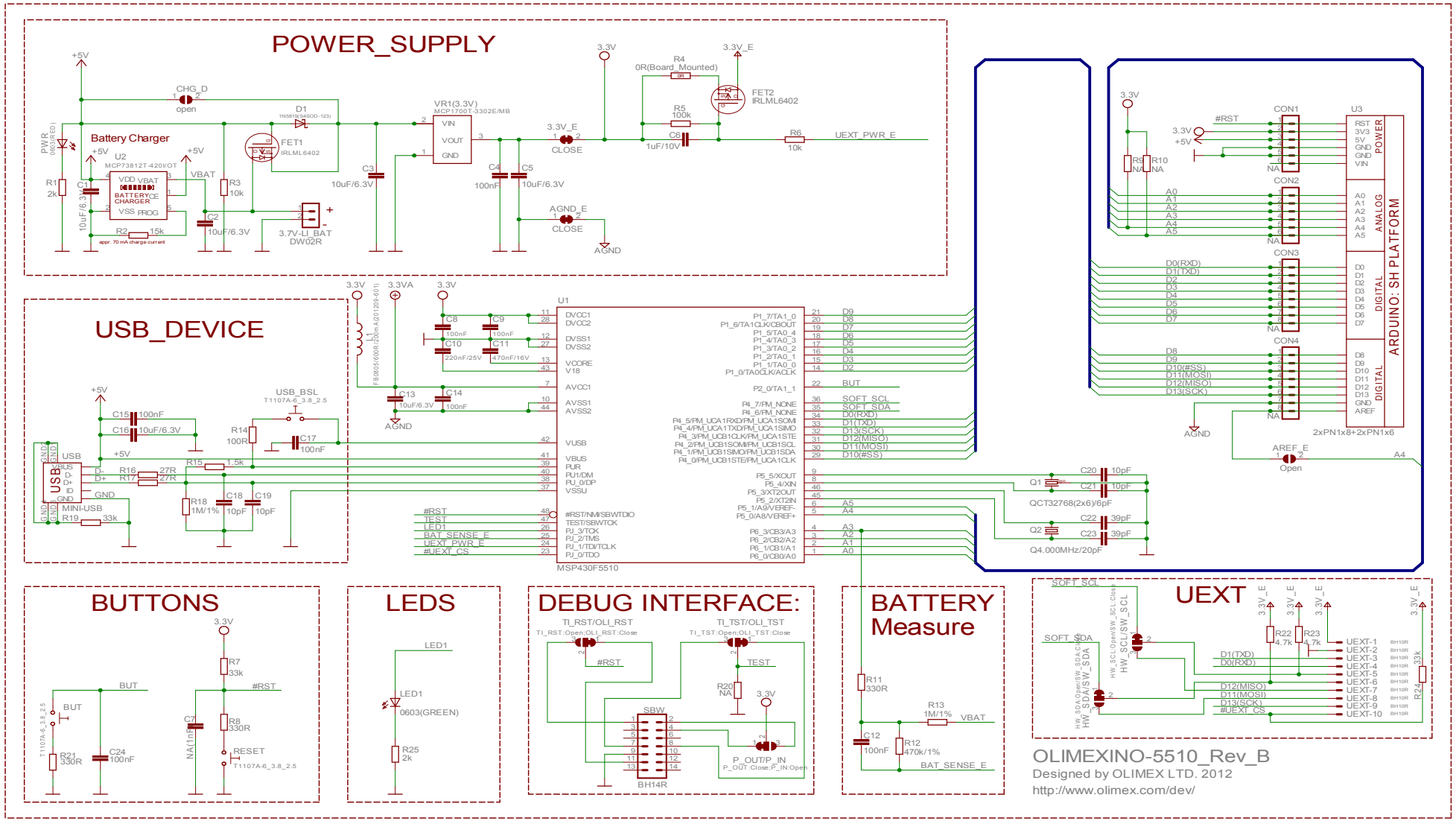
8. Introduction to the chapter

In this chapter you would find the schematics describing logically and physically OLIMEXINO-5510.

8.1 Eagle schematic

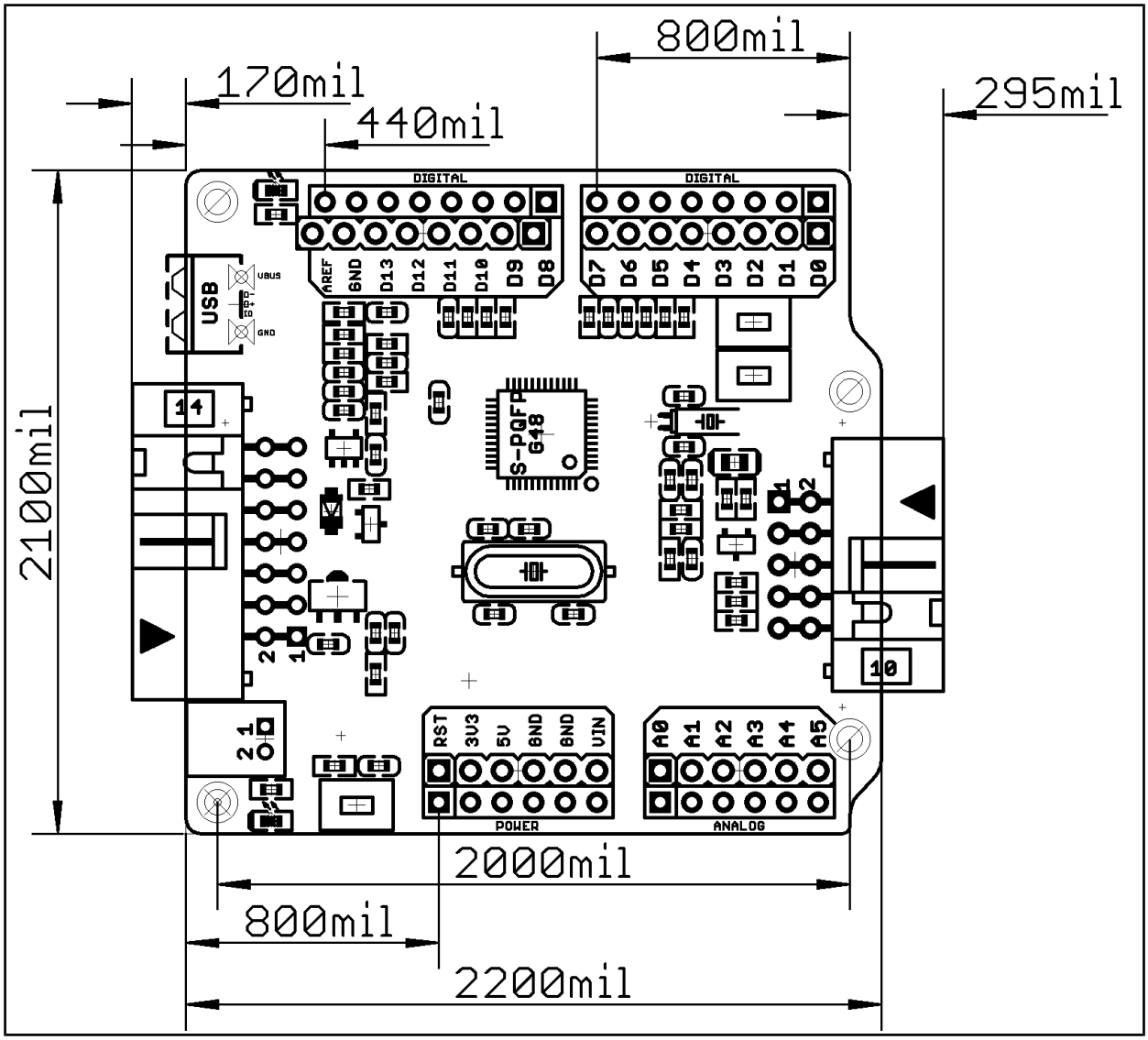
OLIMEXINO-5510's schematics are shown for reference. You can also find them on the web page for OLIMEXINO-5510 at our site: https://www.olimex.com/Products/Duino/MSP430/OLIMEXINO-5510/. They are located in HARDWARE section.

The EAGLE schematic is situated on the next page for quicker reference.


POWER_SUPPLY
Battery Charger
MCP73812T-420I/OT
MCP1700T-3302E/MB
FET1 IRLML6402
FET2 IRLML6402
3.7V-LI_BAT DW02R
USB_DEVICE
MINI-USB
USB_BSL
MSP430F5510
BUTTONS
LEDS
LED1
0603(GREEN)
DEBUG INTERFACE:
TI_RST/OLI_RST
TI_TST/OLI_TST
BH14R
BATTERY Measure
UEXT
SOFT_SCL
SOFT_SDA
ARDUINO: SH PLATFORM
CON1
CON2
CON3
CON4
2xPN1x8+2xPN1x6
QCT32768(2x6)/6pF
Q4.000MHz/20pF
OLIMEXINO-5510_Rev_B
Designed by OLIMEX LTD. 2012
http://www.olimex.com/dev/

8.2 Physical dimensions

Note that all dimensions are in mils.



The three highest elements on the board with same height are: JTAG/SBW connector – 340mil; UEXT connector – 340mil; Arduino shield connectors – 340mil.

CHAPTER 9: REVISION HISTORY AND SUPPORT

9. Introduction to the chapter

In this chapter you will find the current and the previous version of the document you are reading. Also the web-page for your device is listed. Be sure to check it after a purchase for the latest available updates and examples.

9.1 Document revision

Revision, Date	Changes	Modified Page#
A, 31.07.12	Initial Creation	All
B, 07.12.12	Link updates Clarification on the 2-wire debug	5, 7, 8, 23, 24
C, 13.12.12	Fixed wrong info about P_OUT/P_IN jumper	20
D, 27.07.15	Added information about drivers and ways of programming Improved document formatting	All

9.2 Board revision

Revision	Notable Changes
B	Initial release of the board

9.3 Useful web links and purchase codes

The web page you can visit for more info on your device is
https://www.olimex.com/Products/Duino/MSP430/OLIMEXINO-5510/

ORDER CODES:

OLIMEXINO-5510 – OLIMEXINO-5510 featuring MSP430F5510 processor

MSP430-JTAG-TINY-V2 – low cost fast USB JTAG and SWD tool suitable for programming and flash emulation: https://www.olimex.com/Products/MSP430/JTAG/MSP430-JTAG-TINY-V2/

MSP430-JTAG-ISO-V2 – our best MSP430 programmer, featuring LCD display, SD card and stand-alone mode of programming: https://www.olimex.com/Products/MSP430/JTAG/MSP430-JTAG-ISO-MK2/

USB-MINI-CABLE – USB mini to USB-A cable

You can order directly from our web shop or by any of our distributors. Please check the list of distributors: https://www.olimex.com/Distributors/.

Check our web site https://www.olimex.com/ **for more info.**

9.4 Product support

For product support, hardware information and error reports mail to: support@olimex.com. All document or hardware feedback is welcome. Note that we are primarily a hardware company and our software support is limited. Please consider reading the paragraph below about the warranty of Olimex products.

All goods are checked before they are sent out. In the unlikely event that goods are faulty, they must be returned, to OLIMEX at the address listed on your order invoice.

OLIMEX will not accept goods that have clearly been used more than the amount needed to evaluate their functionality.

If the goods are found to be in working condition, and the lack of functionality is a result of lack of knowledge on the customers part, no refund will be made, but the goods will be returned to the user at their expense.

All returns must be authorized by an RMA Number. Email support@olimex.com for authorization number before shipping back any merchandise. Please include your name, phone number and order number in your email request.

Returns for any unaffected development board, programmer, tools, and cables permitted within 7 days from the date of receipt of merchandise. After such time, all sales are considered final.

Returns of incorrect ordered items are allowed subject to a 10% restocking fee. What is unaffected? If you hooked it to power, you affected it. To be clear, this includes items that have been soldered to, or have had their firmware changed. Because of the nature of the products we deal with (prototyping electronic tools) we cannot allow returns of items that have been programmed, powered up, or otherwise changed post shipment from our warehouse.

All returned merchandise must be in its original mint and clean condition. Returns on damaged, scratched, programmed, burnt, or otherwise 'played with' merchandise will not be accepted.

All returns must include all the factory accessories which come with the item. This includes any In-Circuit-Serial-Programming cables, anti-static packing, boxes, etc.

With your return, enclose your PO#. Also include a brief letter of explanation of why the merchandise is being returned and state your request for either a refund or an exchange. Include the authorization number on this letter, and on the outside of the shipping box.

Please note: It is your responsibility to ensure that returned goods reach us. Please use a reliable form of shipping. If we do not receive your package we will not be held liable.

Shipping and handling charges are not refundable. We are not responsible for any shipping charges of merchandise being returned to us or returning working items to you.

The full text might be found at https://www.olimex.com/wiki/GTC#Warranty for future reference.