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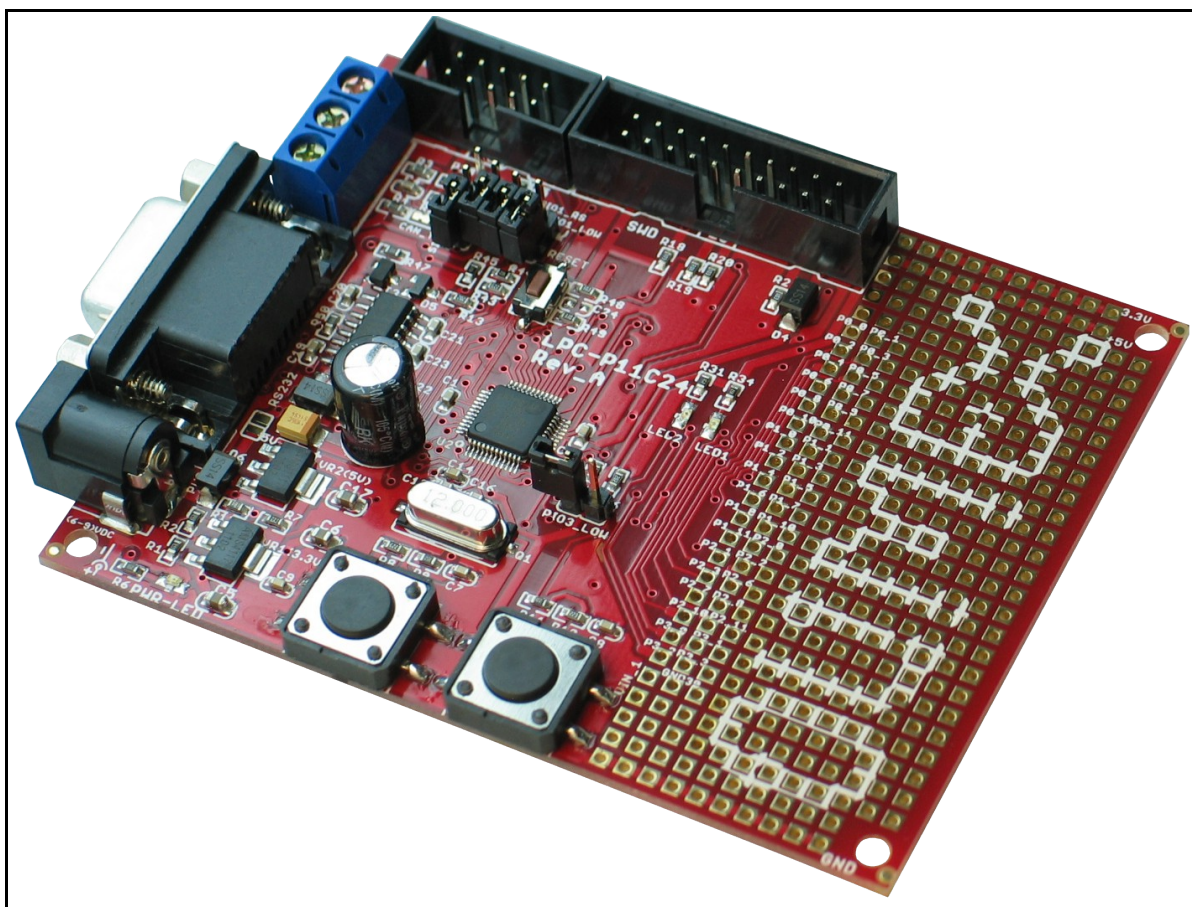
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LPC-P11C24 CORTEX-M0 Development board

USER'S MANUAL

Revision C, March 2013
Designed by OLIMEX Ltd, 2012



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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THERE IS NO WARRANTY FOR THE DESIGN MATERIALS AND THE COMPONENTS USED TO CREATE LPC-P11C24. THEY ARE CONSIDERED SUITABLE ONLY FOR LPC-11C24.

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CHAPTER 1: OVERVIEW

1. Introduction to the chapter

Thank you for choosing the LPC-P11C24 development board from Olimex! This document provides a user's guide for the Olimex LPC-P11C24 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 LPC-P11C24 development board enables code development of applications running on the microcontroller LPC11C24, manufactured by NXP Semiconductors.

1.1 Features

- MCU: LPC11C24 Cortex-M0, up to 50 Mhz, 32 kB Flash, 8kB SRAM, CAN,UART RS-485, two SSP, I2C/Fast+, ADC
- Power supply circuit
- Power-on led
- CAN interface
- RS232 interface
- Debug interface – SWD (Serial Wire Debug)
- UEXT connector
- Two user leds
- Two user buttons
- Reset button
- Prototype area
- Variable input voltage
- FR-4, 1.5 mm, soldermask, component print
- Dimensions: 92x72mm (3.6 x 2.8")

1.2 Target market and purpose of the board

The LPC-P11C24 is a development board with prototyping area. It is suitable for hobbyists in the fields of ARM development.

The strong points of the board are the CAN interface, the built-in bootloader, the proto area and the low price.

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

1.3 Organization

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

- 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 LPC11C14 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 LPC-P11C24 BOARD

2. Introduction to the chapter

This section helps you set up the LPC-P11C24 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

LPC-P11C24 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 Requirements

In order to set up the LPC-P11C24 optimally, the following items are required:

- 7V to 9V source of power with 1A maximum amperage.
- Personal Computer with RS232 port
- RS232-RS232 cable
- TRACE/SWD interface programmer for custom code

Code can be loaded via the RS232-RS232 interface and the bootloader, however it is highly recommended to have a SWD/TRACE programmer at your disposal.

Note that OpenOCD OLIMEX programmers + SWD adapter at the moment of writing are supported only in Rowleys Crossworks for ARM.

2.3 Powering the board

The board is powered via the PWR jack by 7 to 9 volts (preferably closer to the upper limit if you use all peripherals and GPIOs).

When powered by 9V the current measured is around 40mA. The red, green and yellow leds (PWR LED, LED1 and LED2) turn on.

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.

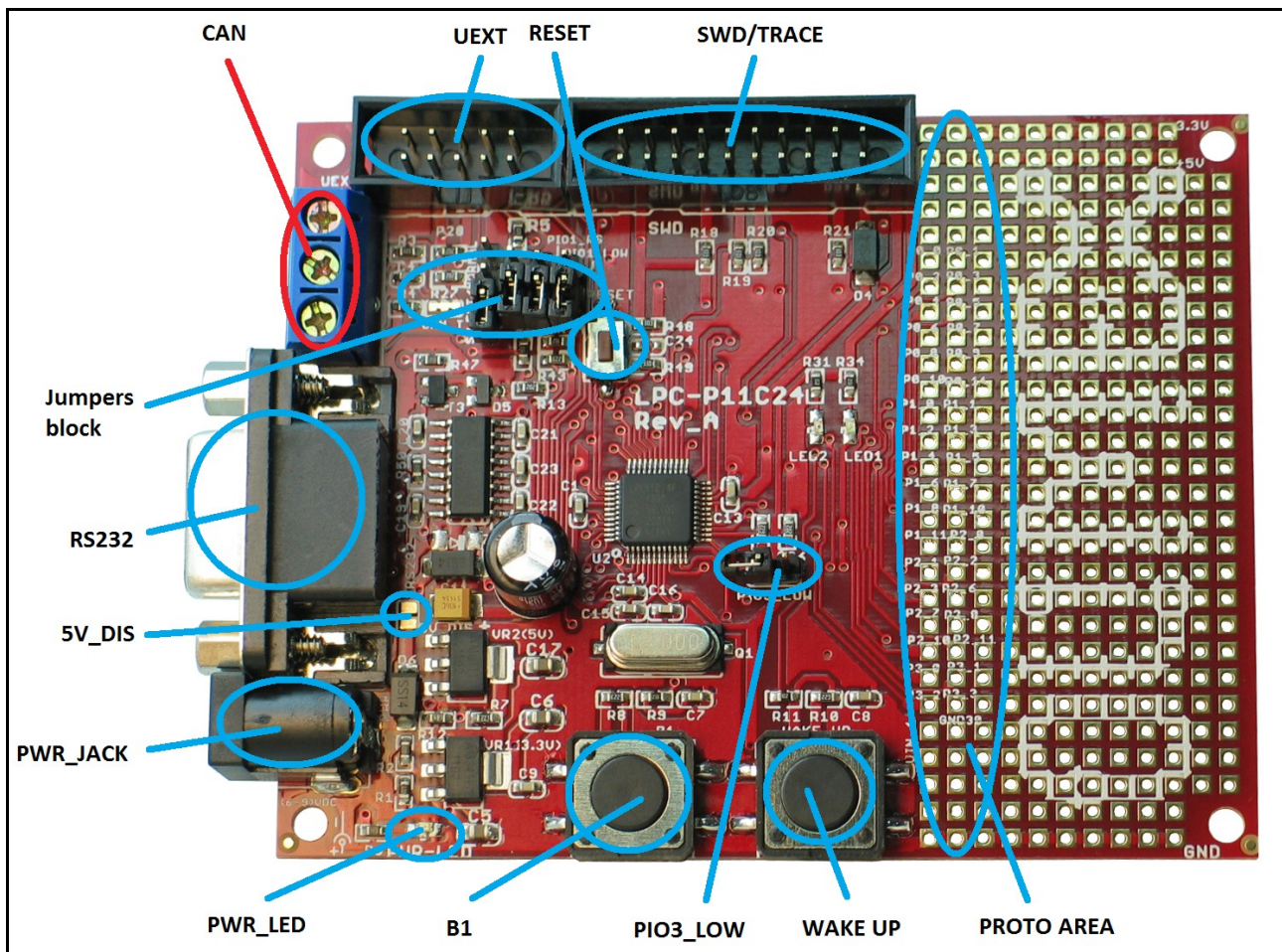
In order to connect with the bootloader you should close PIO1_RS and RST_E jumpers. You will also need RS232 cable and RS232 computer port. After that you can use NXP's FlashMagic software to check if the board is connected successfully. You can also load binary files via the RS232 using the FlashMagic.

CHAPTER 3: LPC-P11C24 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 LPC-P11C24 board itself.

3.1 Layout (top view)



CHAPTER 4: THE LPC11C24 MICROCONTROLLER

4. Introduction to the chapter

In this chapter is located the information about the heart of LPC-P11C24 – its microcontroller. The information is a modified version of the datasheet provided by its manufacturers.

4.1 The microcontroller

- System:
 - ✓ ARM Cortex-M0 processor, running at frequencies of up to 50 MHz.
 - ✓ ARM Cortex-M0 built-in Nested Vectored Interrupt Controller (NVIC).
 - ✓ Serial Wire Debug.
 - ✓ System tick timer.
- Memory:
 - ✓ 32 kB on-chip flash program memory.
 - ✓ 8 kB SRAM data memory.
 - ✓ In-System Programming (ISP) and In-Application Programming (IAP) via on-chip bootloader software. Flash ISP commands can be issued via UART or C_CAN.
- Digital peripherals:
 - ✓ General Purpose I/O (GPIO) pins with configurable pull-up/pull-down resistors.
 - ✓ 36 GPIO pins on the LPC11C24 parts.
 - ✓ GPIO pins can be used as edge and level sensitive interrupt sources.
 - ✓ High-current output driver (20 mA) on one pin.
 - ✓ High-current sink drivers (20 mA) on two I2C-bus pins in Fast-mode Plus.
- Four general purpose counter/timers with a total of four capture inputs 12 match outputs.
- Programmable WatchDog Timer (WDT).
 - ✓ Analog peripherals:
 - ✓ 10-bit ADC with input multiplexing among 8 pins.
- Serial interfaces:
 - ✓ UART with fractional baud rate generation, internal FIFO, and RS-485 support.
 - ✓ Two SPI controllers with SSP features and with FIFO and multi-protocol capabilities.
 - ✓ I2C-bus interface supporting full I2C-bus specification and Fast-mode Plus with a data rate of 1 Mbit/s with multiple address recognition and monitor mode.
 - ✓ C_CAN controller. On-chip C_CAN and CANopen drivers included.
 - ✓ On-chip, high-speed CAN transceiver.
- Clock generation:

- ✓ 12 MHz internal RC oscillator trimmed to 1 % accuracy that can optionally be used as a system clock.
- ✓ Crystal oscillator with an operating range of 1 MHz to 25 MHz.
- ✓ Programmable watchdog oscillator with a frequency range of 7.8 kHz to 1.8 MHz.
- ✓ PLL allows CPU operation up to the maximum CPU rate without the need for a high-frequency crystal. May be run from the system oscillator or the internal RC oscillator.
- ✓ Clock output function with divider that can reflect the system oscillator, IRC, CPU clock, or the Watchdog clock.
- Power control:
 - ✓ Integrated PMU (Power Management Unit) to minimize power consumption during Sleep, Deep-sleep, and Deep power-down modes.
 - ✓ Three reduced power modes: Sleep, Deep-sleep, and Deep power-down.
 - ✓ Processor wake-up from Deep-sleep mode via a dedicated start logic using 13 of the GPIO pins.
 - ✓ Power-On Reset (POR).
 - ✓ Brownout detect with four separate thresholds for interrupt and forced reset.
- Unique device serial number for identification.
- Single 3.3 V power supply (1.8 V to 3.6 V).
- Available as 48-pin LQFP package.

For comprehensive information on the microcontroller visit the Freescale's web page for a datasheet.

At the moment of writing the microcontroller datasheet can be found at the following link:
http://www.nxp.com/documents/data_sheet/LPC11CX2_CX4.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

LPC-P11C24's reset circuit includes R49 (33 Ω), R48 (10k Ω), and a RESET button.

5.2 Clocks

12 MHz quartz crystal Q1 is connected to pins 6 and 7 of the LPC11C24 processor.

5.3 Power supply circuit

The power supply circuit of LPC-P11C24 allows flexible input supply from 7V to 9V. This means a wider range of power supplies, adapters, converters are applicable. The maximum amperage recommended is 1A by default.

After initial power-up the board consumes 40mA @ 9V.

CHAPTER 6: CONNECTORS AND PINOUT

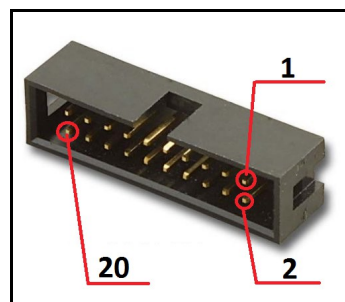
6. Introduction to the chapter

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 SWD debug connector

The TRACE interface is used to program and debug the board.

JTAG/SWD interface			
Pin #	Signal Name	Pin #	Signal Name
1	+3.3V	11	GND
2	+3.3V	12	GND
3	Not connected	13	Not connected
4	GND	14	GND
5	Not connected	15	RST
6	GND	16	GND
7	SWD	17	GND
8	GND	18	GND
9	SWCLK	19	+5V_JTAG
10	GND	20	GND



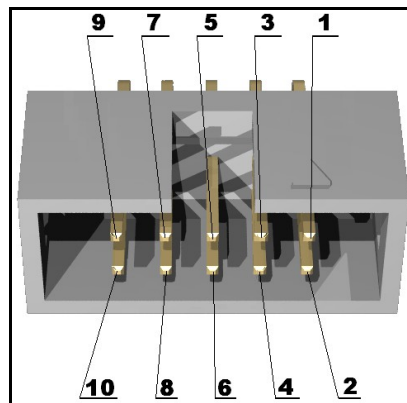
Notice the orientation of the cut on the connector in the picture above.

6.2 UEXT connector

LPC-P11C24 board has a UEXT connector and can interface Olimex's UEXT expansion modules. For more information on UEXT please visit:

<https://www.olimex.com/Products/Modules/UEXT/>

UEXT connector	
Pin #	Signal Name
1	+3.3V
2	GND
3	TXD
4	RXD
5	SCL
6	SDA
7	MISO1
8	MOSI1
9	SCK1
10	SSEL1



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

6.3 Proto area pads

The proto area allows easier and safer analyzing of signals on the board and also provides easier access to free processor pins. In the table below the pads are listed with their corresponding processor pins. When a name of signal is available and written before the processor pin this means the pad is used for the peripheral of the board and provides debug interface. If you wish to use such a pad as GPIO probably you would have to disable some of peripherals on the board.

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

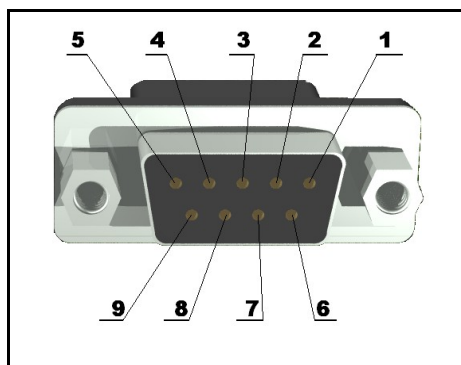
GPIO connector hardware			
Pad name	[Name], Processor pin#	Pad name	[Name], Processor pin#
P0_0	RST, 3	P0_1	ISP_E, 3
P0_2	10	P0_3	PI00_3, 14
P0_4	SCL, 15	P0_5	SDA, 16
P0_6	23	P0_7	B1, 24
P0_8	27	P0_9	28
P0_10	SWCLK, 29	P0_11	32
P1_0	33	P1_1	34
P1_2	35	P1_3	SWD, 39
P1_4	40	P1_5	WAKE_UP, 45
Name	Processor pin#	Name	Processor pin#
P1_6	RXD, 46	P1_7	TXD, 47
P1_8	9	P1_10	LED2, 30
P1_11	LED1, 42	P2_0	SSEL1, 2
P2_1	SCK1, 13	P2_2	MISO1, 26
P2_3	MOSI1, 38	P2_6	1
P2_7	11	P2_8	12
P2_10	25	P2_11	31
P3_0	36	P3_1	37
P3_2	43	P3_3	CAN_MODE, 48
VIN_1	EXTERNAL SUPPLY, CAUTION	GND30	GND

There are also 3.3V row of pads on the top of the proto area, +5V row of pads under the 3.3V one. At the bottom of the proto area there is GND row of pads.

6.4 RS232

RS232's RXD and TXD can be found on the UEXT, on the processor's pins 46 and 47 and on the proto area P1_6 and P1_7.

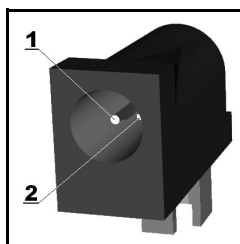
Pin #	Signal Name
1	Not Connected
2	T2OUT
3	R1IN
4	RST
5	GND
6	Not Connected
7	R2IN
8	Not Connected
9	Not Connected



6.5 PWR Jack

The power jack used is the typical 2.5mm one used by Olimex in most of our products. You should provide between 7 and 9 volts @ 1A to the board.

Pin #	Signal Name
1	Power Input
2	GND

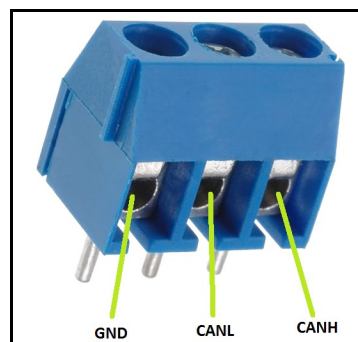


More info about the power supply can be found in chapter 5 of this manual

6.8 CAN interface

There is a CAN connector for controller area network.

CAN		
Pin#	SIGNAL NAME	Processor Pin#
1	GND	-
2	CANL (low)	18
3	CANH (high)	19



6.12 Jumper description

Please note that the jumpers on the board are either PTH or 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.

6.12.1 PIO1_LOW

When open starts user program after reset.

If closed starts the internal bootloader after reset.

The default position is open.

6.12.2 PIO3_LOW

When open PIO3 is high – UART bootloader is selected.

If closed PIO3 is low – CAN bootloader is selected.

The default position is open.

6.12.3 PIO1_RS and RST_E

When both open open UART RTS doesn't control PIO1 and UART DTR doesn't control reset.
 When both closed UART RTS controls PIO1 (if PIO1_LOW is opened), UART_DTR controls RESET.

The default position for both jumpers is open.

6.12.4 SILENT/NORMAL

Silent/Normal jumper alternatively switches the CAN operation mode. Either Silent T or Normal T, you need CAN enabled.

The default position is jumper open.

6.12.5 5V_DIS

When open VR2(5V) is enabled.
If closed disables VR2(5V).

The default position is open.

6.12.6 CAN_T

When closed CAN terminator (2x62 Ohm) is connected.
When open CAN terminator (2x62 Ohm) is disconnected.

The default position is closed.

6.13 Additional hardware components

The components below are mounted on LPC-P11C24 but are not discussed above. They are listed here for completeness:

Reset button - used for hardware reset of the board

B1 and WAKE_UP - buttons

LED1 (Green) + LED2 (Yellow) + Power LED (Red)

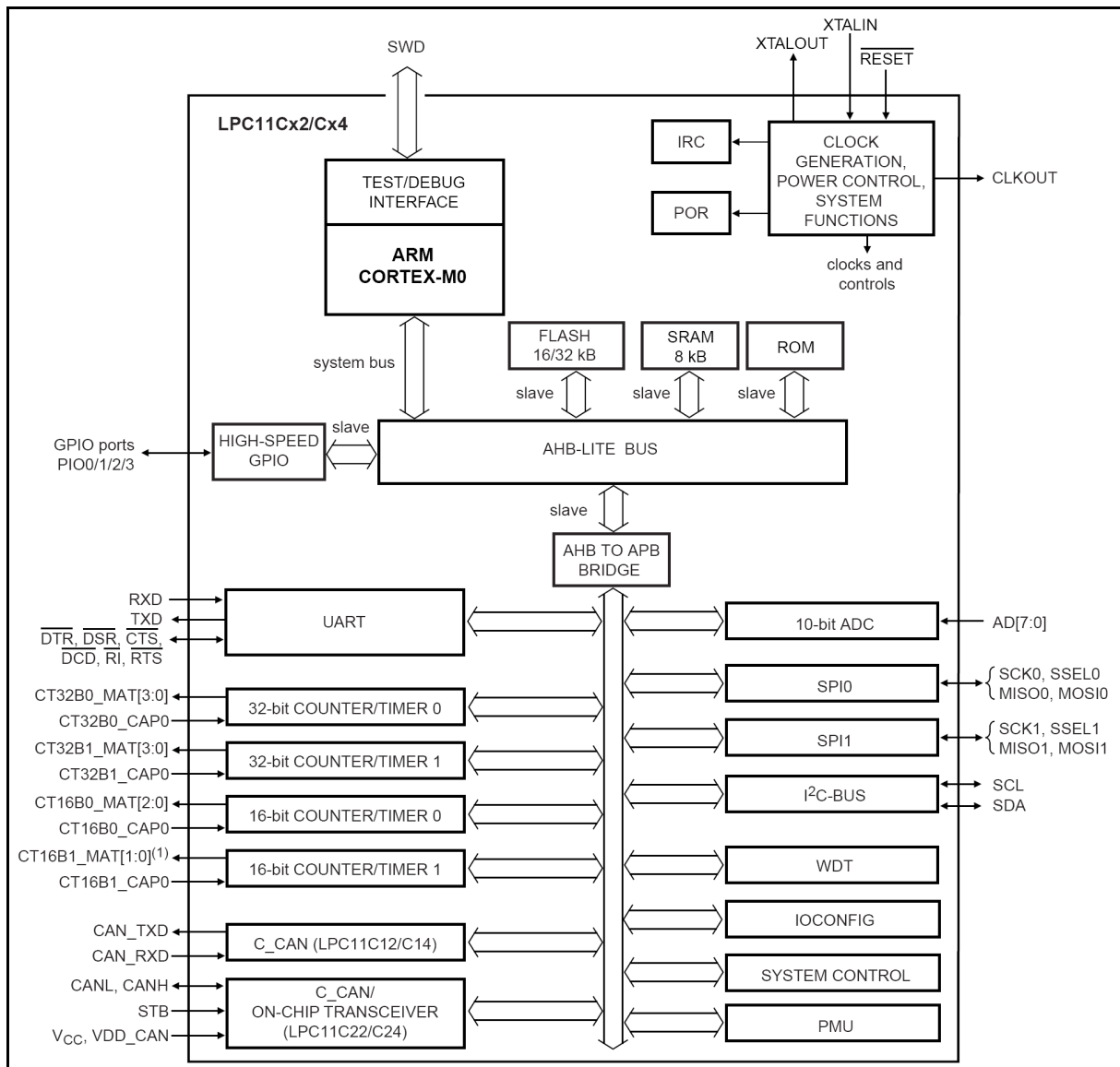
CHAPTER 7: BLOCK DIAGRAM AND MEMORY

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.

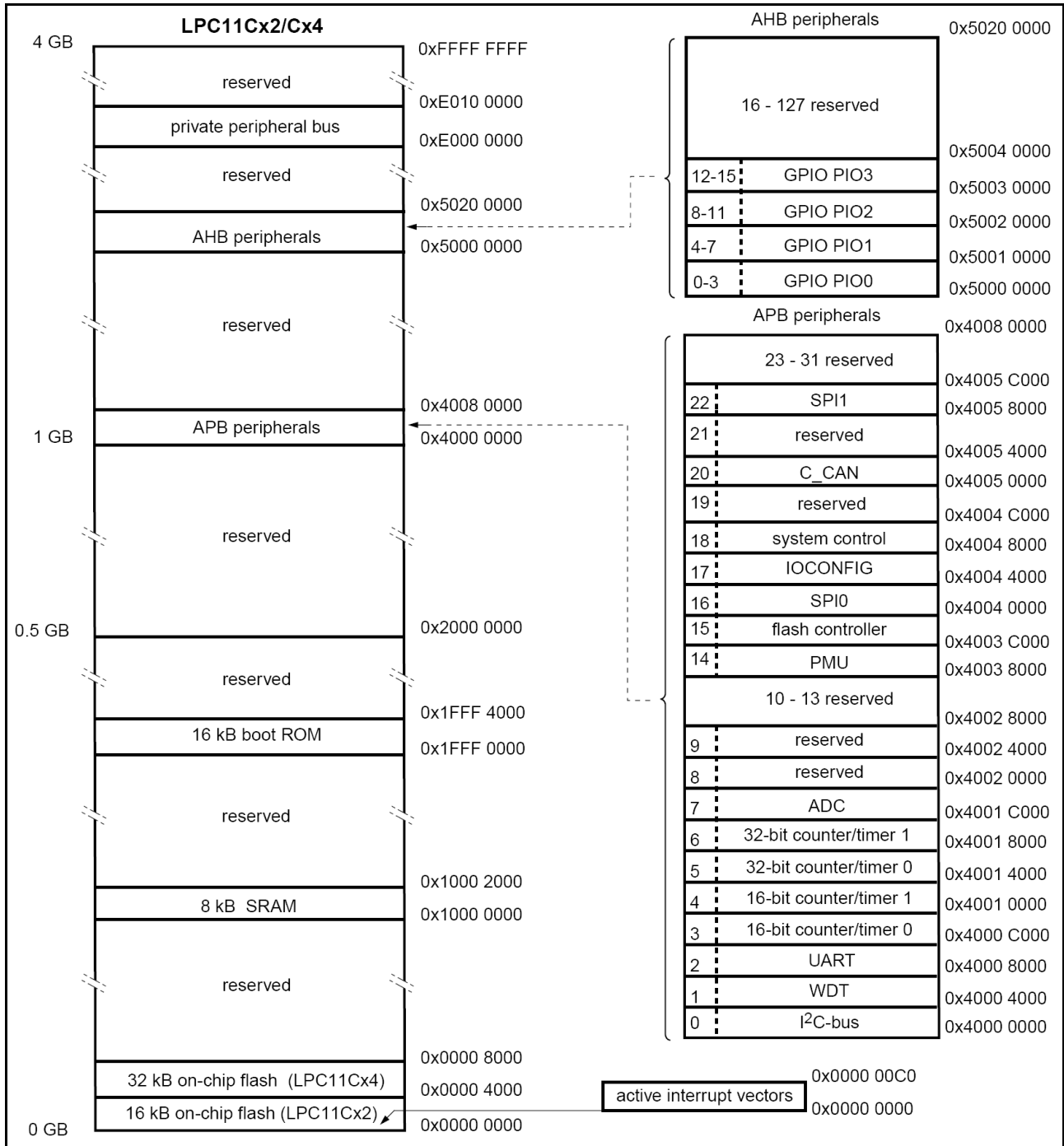
7.2 Processor block diagram

The block diagram is taken from the original datasheet of LPC11Cx2/Cx4.



7.3 Physical memory map

This is the memory map diagram from the original datasheet of LPC 11C24. Note that Cx4 processors have 32kB flash memory.



CHAPTER 8: SCHEMATICS

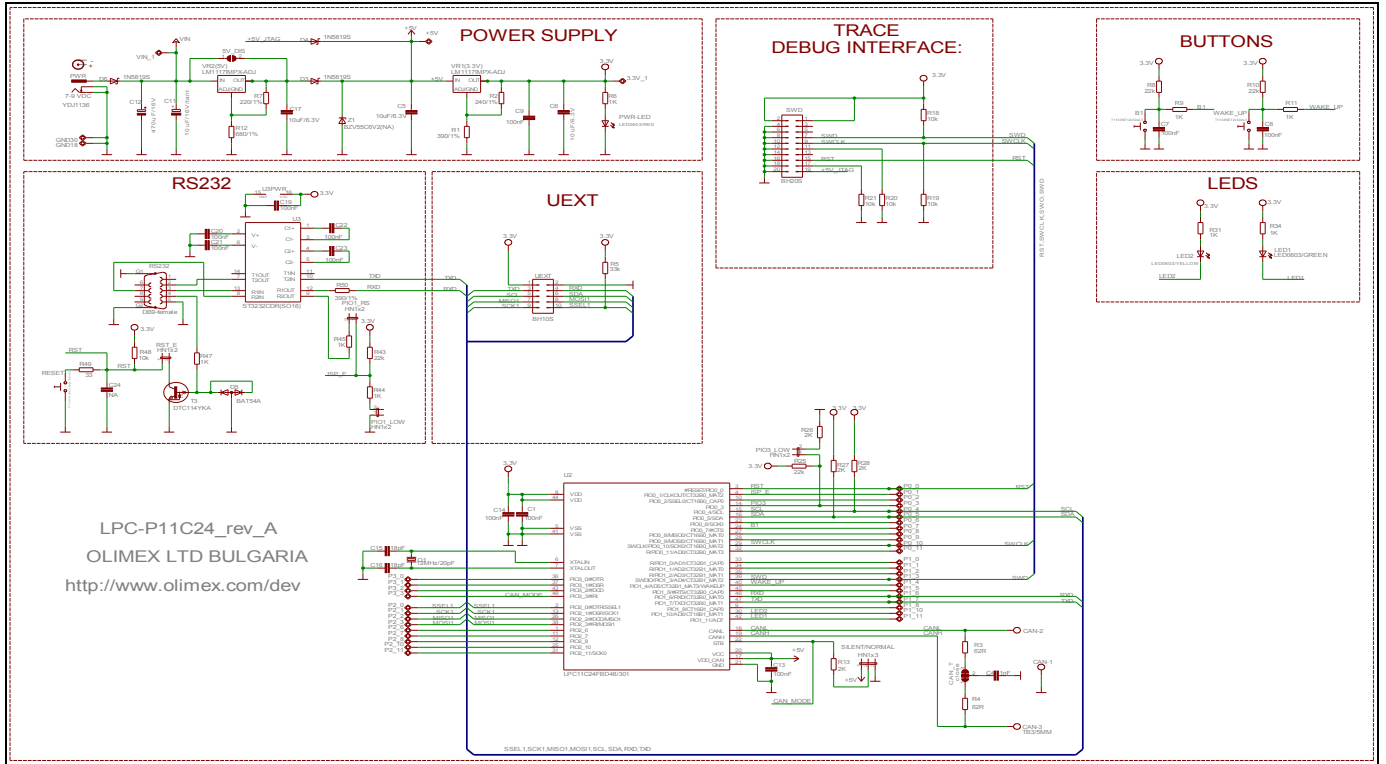
8. Introduction to the chapter

In this chapter are located the schematics describing logically and physically LPC-P11C24.

8.1 Eagle schematic

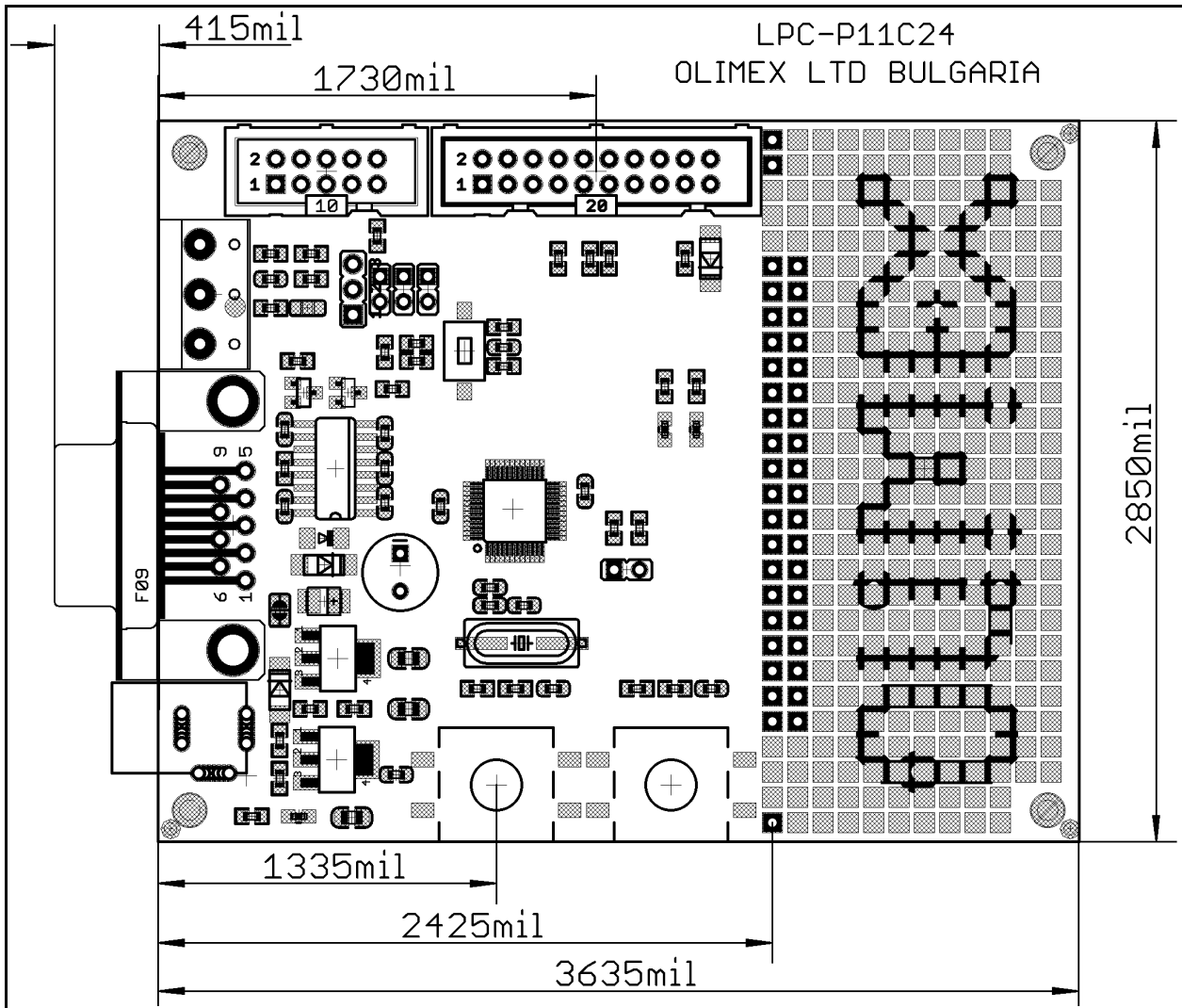
LPC-P11C24 schematic is visible for reference here. You can also find them on the web page for LPC-P11C24 at our site: <https://www.olimex.com/Products/ARM/NXP/LPC-P11C24/>. They are located in HARDWARE section.

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



8.2 Physical dimensions

Note that all dimensions are in inches.



The three highest elements on the board in order from the tallest to the shortest are: RS232 connector – 480mil; capacitor C12 – 460mil; Power jack – 420mil.

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	Changes	Modified Page#
A, 10.07.12	Initial Creation	All
B, 18.10.12	Added links to each entry in the index table; Fixed and updated various links	4, 21, 25
C, 25.03.13	Fixed an error that indicates 6V as sufficient supply voltage; Adjusted formatting; Fixed various links;	7, 8, 12

9.2 Board revision

Revision	Notable Changes
A	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/ARM/NXP/LPC-P11C24/>.

ORDER CODES:

LPC-P11C24 – LPC-P11C24 featuring LPC11C24 Cortex-M0 processor

The latest price list can be found at <https://www.olimex.com/prices>.

How to order?

You can order from our e-shop or via any of our distributors.

Check <https://www.olimex.com/> for more info.

9.3 Product support

For product support, hardware information and error reports mail to: support@olimex.com. 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.

Warranty and returns:

Our boards have lifetime warranty against manufacturing defects and components.

During development work it is not unlikely that you can burn your programmer or development board. This is normal, we also do development work and we have damaged A LOT of programmers and boards during our daily job so we know how it works. If our board/programmer has worked fine then stopped, please check if you didn't apply over voltage by mistake, or shorted something in your target board where the programmer was connected etc. Sometimes boards might get damaged by ESD shock voltage or if you spill coffee on them during your work when they are powered.

Please note that warranty do not cover problems caused by improper use, shorts, over-voltages, ESD shock etc.

If the board has warranty label it should be not broken. Broken labels void the warranty, same applies for boards modified by the customer, for instance soldering additional components or removing components - such boards will be not be a subject of our warranty.

If you are positive that the problem is due to manufacturing defect or component you can return the board back to us for inspection.

When we receive the board we will check and if the problem is caused due to our fault and we will repair/replace the faulty hardware free of charge, otherwise we can quote price of the repair.

Note that all shippings back and forth have to be covered by the customer. Before you ship anything back you need to ask for RMA. When you ship back please attach to it your shipping address, phone, e-mail, RMA# and brief description of the problem. All boards should be sent back in antistatic package and well packed to prevent damages during the transport.