

MOD-IO2 extension board USER'S MANUAL

Revision B, October 2012
Designed by OLIMEX Ltd, 2012



All boards produced by Olimex LTD are ROHS compliant

DISCLAIMER

© 2012 Olimex Ltd. Olimex®, logo and combinations thereof, are registered trademarks of Olimex Ltd. Other product names may be trademarks of others and the rights belong to their respective owners.

The information in this document is provided in connection with Olimex products. No license, express or implied or otherwise, to any intellectual property right is granted by this document or in connection with the sale of Olimex products.

The hardware part of the project is NOT open-source. This means we will not provide source schematics and board layout.

The software is released under the GPL.

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

The product described in this document is subject to continuous development and improvements. All particulars of the product and its use contained in this document are given by OLIMEX in good faith. However all warranties implied or expressed including but not limited to implied warranties of merchantability or fitness for purpose are excluded. This document is intended only to assist the reader in the use of the product. OLIMEX Ltd. shall not be liable for any loss or damage arising from the use of any information in this document or any error or omission in such information or any incorrect use of the product.

This evaluation board/kit is intended for use for engineering development, demonstration, or evaluation purposes only and is not considered by OLIMEX to be a finished end-product fit for general consumer use. Persons handling the product must have electronics training and observe good engineering practice standards. As such, the goods being provided are not intended to be complete in terms of required design-, marketing-, and/or manufacturing-related protective considerations, including product safety and environmental measures typically found in end products that incorporate such semiconductor components or circuit boards.

Olimex currently deals with a variety of customers for products, and therefore our arrangement with the user is not exclusive. Olimex assumes no liability for applications assistance, customer product design, software performance, or infringement of patents or services described herein.

THERE IS NO WARRANTY FOR THE DESIGN MATERIALS AND THE COMPONENTS USED TO CREATE MOD-IO2. THEY ARE CONSIDERED SUITABLE ONLY FOR MOD-IO2.

Table of Contents

DISCLAIMER.....	2
CHAPTER 1 OVERVIEW.....	5
1. Introduction to the chapter.....	5
1.1 Features.....	5
1.2 MOD-IO vs MOD-IO2.....	5
1.3 Target market and purpose of the board.....	6
1.4 Organization.....	6
CHAPTER 2 SETTING UP THE MOD-IO2 BOARD.....	7
2. Introduction to the chapter.....	7
2.1 Electrostatic warning.....	7
2.2 Requirements.....	7
2.3 Powering the board.....	8
2.4 Prebuilt software.....	8
CHAPTER 3 MOD-IO2 BOARD DESCRIPTION.....	9
3. Introduction to the chapter.....	9
3.1 Layout (top view).....	9
CHAPTER 4 THE PIC16F1503 MICROCONTROLLER.....	10
4. Introduction to the chapter.....	10
4.1 The PIC16F1503 features.....	10
CHAPTER 5 CONNECTORS AND PINOUT.....	12
5. Introduction to the chapter.....	12
5.1 ICSP	12
5.2 UEXT modules.....	12
5.2.1 Female connector.....	13
5.2.2 Male connector.....	13
5.3 Relay output connectors.....	13
5.4 GPIO connectors.....	14
5.5 PWR Jack.....	15
5.6 Jumper description.....	15
5.6.1 PROG.....	15
5.6.2 SDA_E/SCL_E.....	15
5.6.3 UEXT_FPWR_E.....	15
5.6.4 UEXT_MPWR_E.....	16
5.7 Additional hardware components.....	16
CHAPTER 6 BLOCK DIAGRAM AND MEMORY.....	17
6. Introduction to the chapter.....	17
6.1 Processor block diagram.....	17

<u>6.2 Physical memory map.....</u>	<u>18</u>
<u>CHAPTER 7 SCHEMATICS.....</u>	<u>19</u>
<u>7. Introduction to the chapter.....</u>	<u>19</u>
<u>7.1 Eagle schematic.....</u>	<u>19</u>
<u>7.2 Physical dimensions.....</u>	<u>21</u>
<u>CHAPTER 8 REVISION HISTORY AND SUPPORT.....</u>	<u>22</u>
<u>8. Introduction to the chapter.....</u>	<u>22</u>
<u>8.1 Document revision.....</u>	<u>22</u>
<u>8.2 Board's revision.....</u>	<u>22</u>
<u>8.3 Useful web links and purchase codes.....</u>	<u>23</u>
<u>8.4 Product support.....</u>	<u>24</u>

CHAPTER 1 OVERVIEW

1. Introduction to the chapter

Thank you for choosing the MOD-IO2 single board computer from Olimex! This document provides a user's guide for the Olimex MOD-IO2 board. As an overview, this chapter gives the scope of this document and lists the board's features. The differences between the members of the MOD-IO2 and MOD-IO boards are mentioned. The document's organization is then detailed. The MOD-IO2 development board enables code development of applications running on the microcontroller PIC16F1503, manufactured by Microchip.

1.1 Features

- ◆ PIC16F1503 microcontroller
- ◆ ICSP 6 pin connector for in-circuit programming with PIC-ICD2-POCKET and PIC-KIT3 or other compatible programmer/debugger.
- ◆ 9-pin terminal screw connector for 7 GPIOs 3.3V and GND
- ◆ PWR jack for 12VDC
- ◆ 7 GPIOs which could implement different functionality as PWM, SPI, I2C etc.
- ◆ 2 relay outputs with 15A/250VAC contacts with screw terminals
- ◆ RELAY output status LEDs
- ◆ Both male and female UEXT connectors
- ◆ Four mounting holes 3.3 mm (0.13")
- ◆ UEXT female-female cable included
- ◆ FR-4, 1.5 mm (0.062"), soldermask, white silkscreen component print
- ◆ dimensions 61x52 mm (2.4 x 2.05")

1.2 MOD-IO vs MOD-IO2

MOD-IO2 is a smaller input output extension module compared to MOD-IO both in terms of size and in terms of functionality, however in a lot of situations MOD-IO2 might provide the better choice. Designs which need optocouplers should consider MOD-IO. In a lot of the other cases MOD-IO2 might be the better choice since it is possible to stack multiple MOD-IO2's over each other.

MOD-IO has a better power supply with the option to be supplied in the range of 8-30VDC.

1.3 Target market and purpose of the board

MOD-IO2 is an extension development board which can interface other Olimex boards via UEXT connector it adds add RELAYs and GPIOs. Multiple MOD-IO2s are stackable and addressable. The firmware allows you to interact with the board using simple commands and yet if you wish you can modify the firmware for your needs.

If you work with any of our development boards with UEXT connector and you need more GPIOs and RELAY outputs you can add these by connecting MOD-IO2 to your development board. This board allows easy interfacing to 2 relays and 7 GPIOs. MOD-IO2 is stackable and addressable - these boards can be plugged together and you can add as many inputs and outputs as you want! 2-4-6-8 etc! MOD-IO2 has PIC16F1503 microcontroller and the firmware is open source and available for modification.

The board is a very good addition to most of the Olimex boards if you need analog signals.

1.4 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
- Chapter 3 contains the general board diagram and layout
- Chapter 4 describes the component that is the heart of the board: the PIC16F1503
- Chapter 5 covers the connector pinout, peripherals and jumper description
- Chapter 6 shows the memory map
- Chapter 7 provides the schematics
- Chapter 8 contains the revision history, useful links and support information

CHAPTER 2 SETTING UP THE MOD-IO2 BOARD

2. Introduction to the chapter

This section helps you set up the MOD-IO2 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

MOD-IO2 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 MOD-IO2 optimally, the following items are required:

- Any OLIMEX board that has an UEXT connector
- 12V source of power

If you wish to reprogram the board or modify the firmware you will also need:

- PIC ICSP compatible programmer – not that the connector for the ICSP programming is the standard 0.1" one. We have a cheap compatible PIC16F1503 programmer based on Microchip's PIC-KIT3.

Some of the suggested items can be purchased by Olimex, for instance:

- PIC-KIT3** – Olimex programmer capable of programming PIC16F1503
- SY0612E** - power supply adapter 12V/0.5A for european customers

2.3 Powering the board

The board is powered by the power jack. You should provide 12V DC.

For the European customers we sell an affordable power supply adapter 12V/0.5A – **SY0612E**.

If you power the board correctly PWR_LED

2.4 Prebuilt software

Upon powering initially the board's red PWR_LED and the green LED_REL1 should turn on.

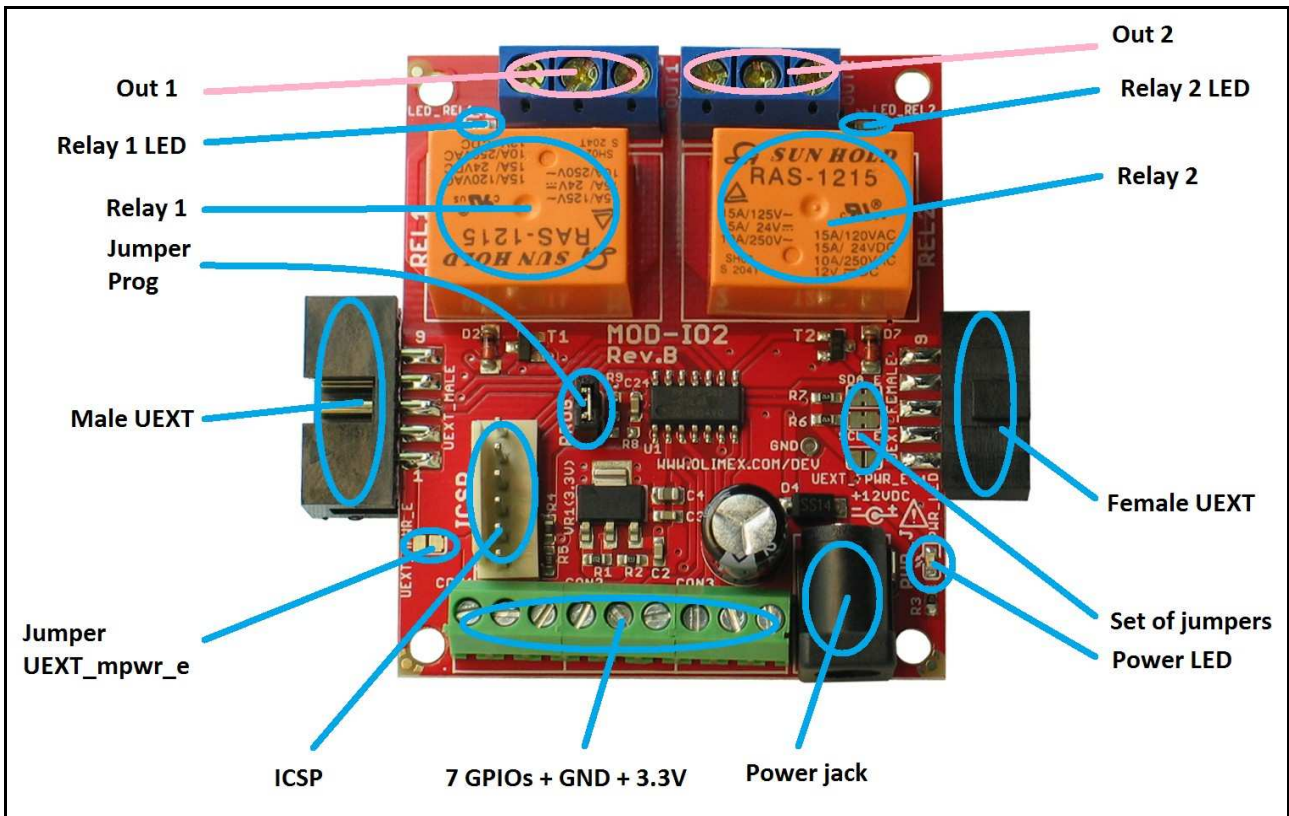
Detailed explanation of the preloaded software may be found in the demo package available at our web-page.

CHAPTER 3 MOD-IO2 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 differ from the names used to describe them. For the actual names check the MOD-IO2 board itself.

3.1 Layout (top view)



CHAPTER 4 THE PIC16F1503 MICROCONTROLLER

4. Introduction to the chapter

In this chapter is located the information about the heart of MOD-IO2 – its PIC16 microcontroller. The information below is a modified version of the datasheet provided by its manufacturers from Microchip.

4.1 The PIC16F1503 features

- Enhanced Mid-range Core with 49 Instruction, 16 Stack Levels
- Flash Program Memory with self read/write capability
- Internal 16MHz oscillator
- 4x Standalone PWM Modules
- Complementary Waveform Generator (CWG) Module
- Numerically Controlled Oscillator (NCO) Module
- 2x Configurable Logic Cell (CLC) Modules
- Integrated Temperature Indicator Module
- 8 Channel 10-bit ADC with Voltage Reference
- 5-bit Digital to Analog Converter (DAC)
- I²C, SPI
- 25mA Source/Sink current I/O
- 2x 8-bit Timers (TMR0/TMR2)
- 1x 16-bit Timer (TMR1)
- Extended Watchdog Timer (WDT)
- Enhanced Power-On/Off-Reset
- Low-Power Brown-Out Reset (LPBOR)
- Programmable Brown-Out Reset (BOR)
- In Circuit Serial Programming (ICSP)
- In-Circuit Debug using a Debug Header
- PIC16LF1503 (1.8V – 3.6V)
- PIC16F1503 (2.3V – 5.5V)

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

At the moment of writing the microcontroller datasheet can be found at the following link:
<http://ww1.microchip.com/downloads/en/DeviceDoc/41607A.pdf>.

CHAPTER 5 CONNECTORS AND PINOUT

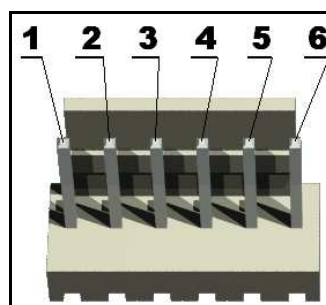
5. Introduction to the chapter

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.

5.1 ICSP

The board can be programmed and debugged from the 6-pin ICSP. Below is the table of the JTAG. This interface can be used with the Olimex's PIC-KIT3 debuggers.

ICSP			
Pin #	Signal Name	Pin #	Signal Name
1	MCLR	4	GPI00_ICSPDAT
2	+3.3V	5	GPI00_ICSPCLK
3	GND	6	Not connected



5.2 UEXT modules

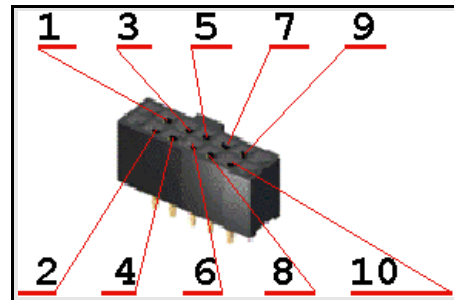
MOD-IO2 board has two UEXT connectors (male and female) and can interface Olimex's UEXT boards.

For more information on UEXT please visit: <http://www.olimex.com/dev/OTHER/UEXT.pdf>

5.2.1 Female connector

The female connector is used either to connect to a board directly (without using the female-female cable) or to connect the module to another MOD-IO2 – to create a stackable module that can be addressed via the I2C.

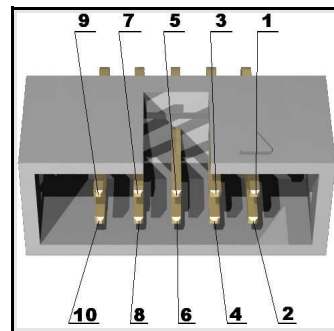
Female UEXT			
Pin #	Signal Name	Pin #	Signal Name
1	+3.3V	6	SDA
2	GND	7	Not connected
3	Not connected	8	Not connected
4	Not connected	9	Not connected
5	SCL	10	Not connected



5.2.2 Male connector

The male connector is used with the ribbon cable in the package to connect to another male UEXT or to connected to another MOD-IO2

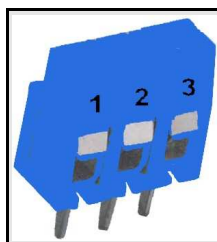
Male UEXT			
Pin #	Signal Name	Pin #	Signal Name
1	+3.3V	6	SDA
2	GND	7	Not connected
3	Not connected	8	Not connected
4	Not connected	9	Not connected
5	SCL	10	Not connected



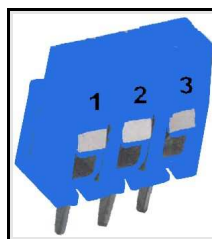
5.3 Relay output connectors

There are two relays in MOD-IO. Their output signals are the standard Normal Closed (NC), Normal Open (NO) and the Common (COM).

REL1 - OUT1	
Pin #	Signal Name
1	NO - normal open
2	NC - normal closed
3	COM - common



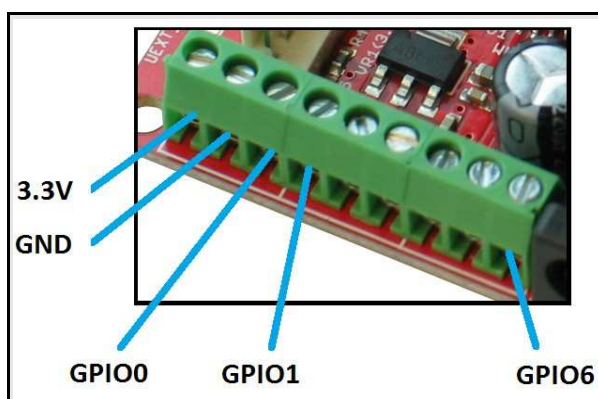
REL2 - OUT2	
Pin #	Signal Name
1	COM - common
2	NO - normal open
3	NC - normal closed



5.4 GPIO connectors

The GPIO connectors can be used to implement PWM, I2C, SPI, etc. Note that the names of each pin are printed on the bottom of the board also

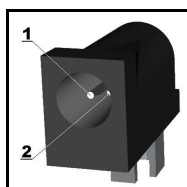
Pin #	Signal Name
1	3.3V
2	GND
3	GPIO0
4	GPIO1
5	GPIO2
6	GPIO3
7	GPIO4
8	GPIO5
9	GPIO6



5.5 PWR Jack

The power jack used is the typical 2.5mm one used by Olimex in most of our products. You should provide 12 @ 1A to the board.

Pin #	Signal Name
1	Power Input
2	GND



5.6 Jumper description

Please note that almost all (except PROG) of the jumpers on the board are SMD type. If you feel insecure in your soldering/cutting technique it is better not to try adjusting SMD jumpers. Also if you feel incapable of removing the PTH jumper with hands better use tweezers.

5.6.1 PROG

When closed this jumper allows addressing a single MOD-IO2 (the one with the closed jumper) over all others stacked to it – since initially all connected MOD-IO2 boards have the same address. After you have closed PROG on one of the MOD-IO2s you can communicate with that one via the UEXT using the commands found in the commands list that can be found on the product's web page.

Default position is open.

5.6.2 SDA_E/SCL_E

When you have more than one MOD-IO2 connected you need to keep those two jumpers closed, else the I2C line will be disconnected.

The default positions for both jumpers are closed/soldered.

5.6.3 UEXT_FPWR_E

If closed provides 3.3V at the female UEXT connector. (be careful since if you close that jumper and also you close the male one on the next MOD-IO2 line this might cause electrical burn to the

board.

Default position is open/unsoldered.

5.6.4 UEXT_MPWR_E

If closed provides 3.3V at the male UEXT connector. (be careful since if you close that jumper and also you close the female one on the next MOD-IO2 line this might cause electrical burn to the board.

The default position is open/unsoldered.

5.7 Additional hardware components

The components below are mounted on MOD-IO2 but are not discussed above. They are listed here for completeness:

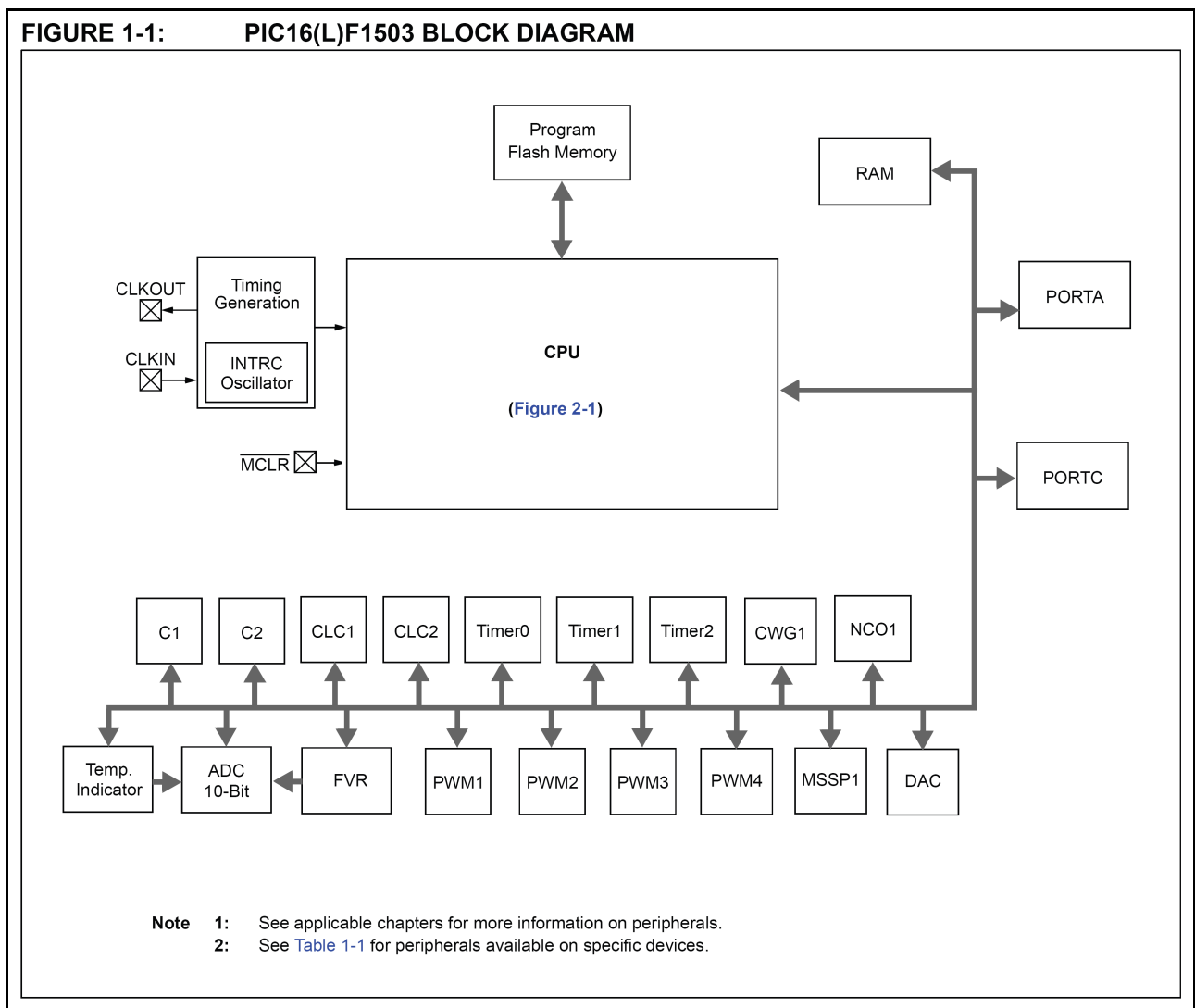
Relay LEDs + Power LED

CHAPTER 6 BLOCK DIAGRAM AND MEMORY

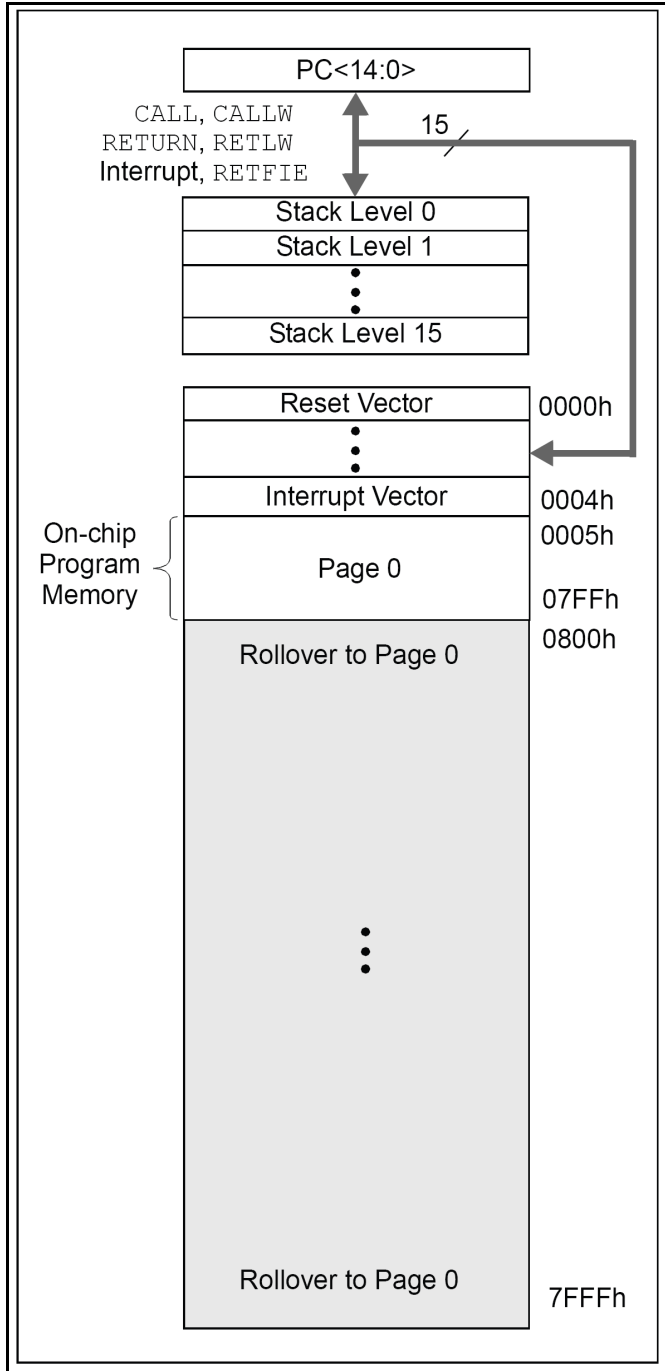
6. Introduction to the chapter

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

6.1 Processor block diagram



6.2 Physical memory map



CHAPTER 7 SCHEMATICS

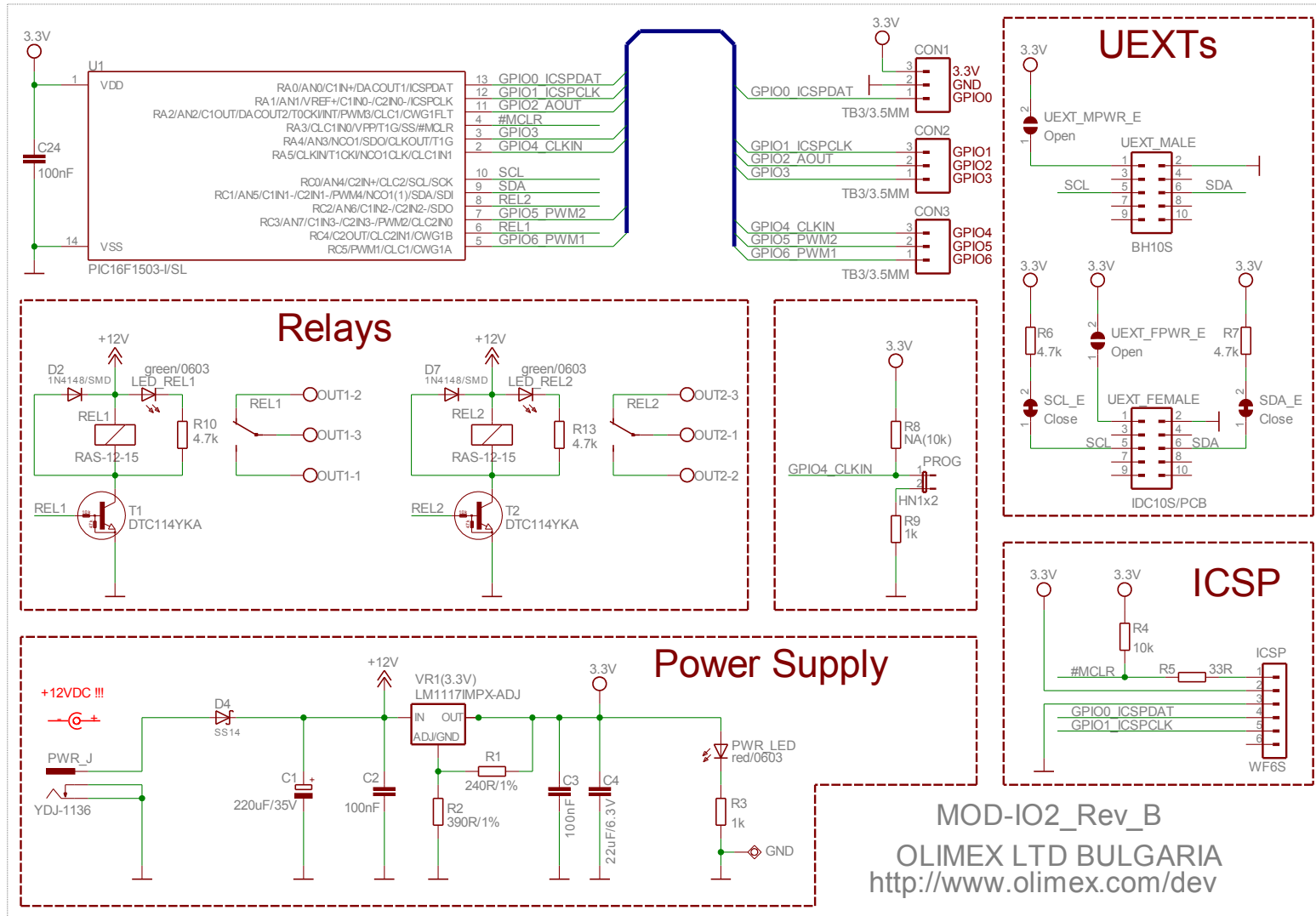
7. Introduction to the chapter

In this chapter are located the schematics describing logically and physically MOD-IO2.

7.1 Eagle schematic

MOD-IO2 schematic is visible for reference here. You can also find it on the web page for MOD-IO2 at our site: <https://www.olimex.com/dev/mod-io2.html>. They are located in HARDWARE section.

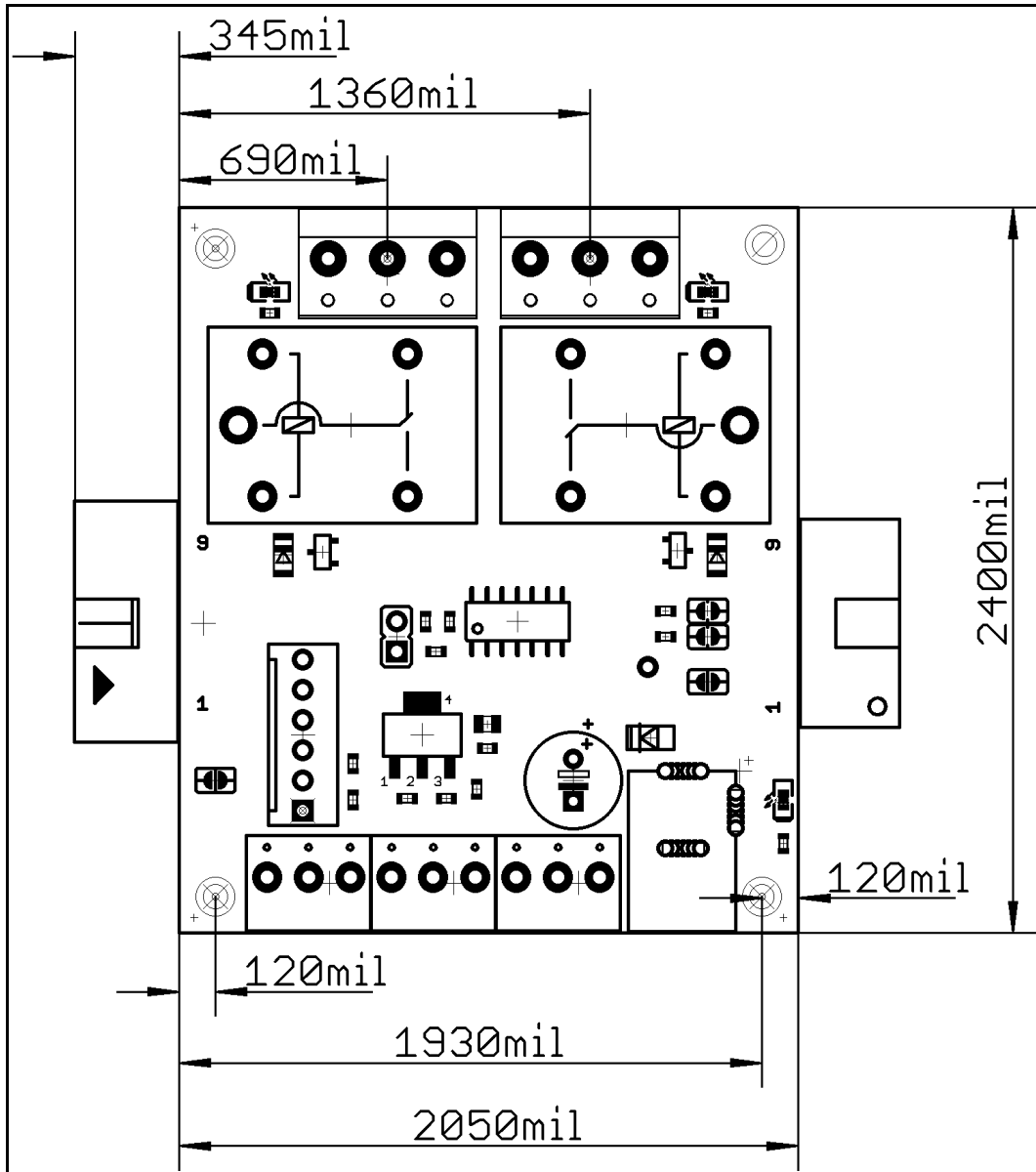
The EAGLE schematic is situated on the next page for quicker reference.



MOD-IO2_Rev_B
 OLIMEX LTD BULGARIA
<http://www.olimex.com/dev>

7.2 Physical dimensions

Note that all dimensions are in mils.



The three highest elements on the board in order from the tallest to the shortest are: relay T1 – 0.600" (15.25 mm) over the pcb; relay T2 – 0.600" (15.25 mm); ICSP connector – 0.450" (11.43 mm).

Note that the above measures does not include the PCB.

CHAPTER 8 REVISION HISTORY AND SUPPORT

8. 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.

8.1 Document revision

Revision	Changes	Modified Page#
A, 27.08.12	- Initial Creation	All
B, 16.10.12	- Fixed several leftovers from the template which were referencing wrong processors and boards - Updated links	6, 10, 20

8.2 Board's revision

Revision, Date	Revision Notes
B, 18.06.12	Initial release

8.3 Useful web links and purchase codes

The web page you can visit for more info on your device is <https://www.olimex.com/dev/mod-io2.html>.

ORDER CODES:

MOD-IO2 – the version of the board discussed in this document

MOD-IO – the bigger version with optocouplers and 8-30VDC power option

PIC-KIT3 – Olimex programmer capable of programming MOD-IO2

SY0612E - power supply adapter 12V/0.5A for MOD-IO2 – 220V (European compatibility)

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

How to order?

You can order from our web shop or purchase from any of our distributors.

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

8.4 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.