

PIC32-T795 development board USER'S MANUAL

Revision F, August 2014
Designed by OLIMEX Ltd, 2012



All boards produced by Olimex LTD are ROHS compliant

DISCLAIMER

© 2013 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.

This work is licensed under the Creative Commons Attribution-ShareAlike 3.0 Unported License. To view a copy of this license, visit <http://www.creativecommons.org/licenses/by-sa/3.0/>.



This hardware design by Olimex LTD is licensed under a Creative Commons Attribution-ShareAlike 3.0 Unported License.

The software is released under 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 PIC32-T795. THEY ARE CONSIDERED SUITABLE ONLY FOR PIC32-T795.

Table of Contents

<u>DISCLAIMER.....</u>	<u>2</u>
<u>CHAPTER 1 OVERVIEW.....</u>	<u>5</u>
<u>1. Introduction to the chapter.....</u>	<u>5</u>
<u>1.1 Features.....</u>	<u>5</u>
<u>1.2 Organization.....</u>	<u>5</u>
<u>CHAPTER 2 SETTING UP THE PIC32-T795 BOARD.....</u>	<u>7</u>
<u>2. Introduction to the chapter.....</u>	<u>7</u>
<u>2.1 Electrostatic warning.....</u>	<u>7</u>
<u>2.2 Requirements.....</u>	<u>7</u>
<u>2.3 Powering the board.....</u>	<u>8</u>
<u>2.4 Prebuilt software.....</u>	<u>8</u>
<u>CHAPTER 3 PIC32-T795 BOARD DESCRIPTION.....</u>	<u>9</u>
<u>3. Introduction to the chapter.....</u>	<u>9</u>
<u>3.1 Layout (top view).....</u>	<u>9</u>
<u>3.2 Layout (bottom view).....</u>	<u>10</u>
<u>CHAPTER 4 THE PIC32MX795F512H MICROCONTROLLER.....</u>	<u>11</u>
<u>4. Introduction to the chapter.....</u>	<u>11</u>
<u>4.1 The microcontroller.....</u>	<u>11</u>
<u>CHAPTER 5 CONTROL CIRCUITY.....</u>	<u>13</u>
<u>5. Introduction to the chapter.....</u>	<u>13</u>
<u>5.1 Reset.....</u>	<u>13</u>
<u>5.2 Clock.....</u>	<u>13</u>
<u>CHAPTER 6 HARDWARE.....</u>	<u>14</u>
<u>6. Introduction to the chapter.....</u>	<u>14</u>
<u>6.1 ICSP connector.....</u>	<u>14</u>
<u>6.2 UEXT.....</u>	<u>14</u>
<u>6.3 Pinout of the row headers at the bottom.....</u>	<u>15</u>
<u>6.4 USB OTG.....</u>	<u>16</u>
<u>6.5 Jumper description.....</u>	<u>17</u>
<u>6.6 Additional hardware components.....</u>	<u>18</u>
<u>CHAPTER 7 MEMORY.....</u>	<u>19</u>
<u>7. Introduction to the chapter.....</u>	<u>19</u>
<u>7.1 Block diagram of the processor.....</u>	<u>19</u>
<u>7.2 Memory map.....</u>	<u>20</u>
<u>CHAPTER 8 SCHEMATICS.....</u>	<u>21</u>
<u>8. Introduction to the chapter.....</u>	<u>21</u>

<u>8.1 Eagle schematic.....</u>	<u>21</u>
<u>8.2 Physical dimensions.....</u>	<u>23</u>
<u>CHAPTER 9 REVISION HISTORY.....</u>	<u>24</u>
<u>9. Introduction to the chapter.....</u>	<u>24</u>
<u>9.1 Document revision.....</u>	<u>24</u>
<u>9.2 Web page of your device.....</u>	<u>25</u>
<u>9.3 Product support.....</u>	<u>26</u>

CHAPTER 1 OVERVIEW

1. Introduction to the chapter

Thank you for choosing the PIC32-T795 development board from Olimex! This document provides a User's Guide for the Olimex PIC32-T795 development 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 PIC32-T795 development board enables code development of applications running on the PIC32MX795F512H microcontroller, manufactured by Microchip.

1.1 Features

- PIC32MX795F512H 80 Mhz microcontroller 512KB Flash 128KB RAM , 3x SPI, 4x I2C, USB OTG, 1MSPS ADC, PMP 80Mhz digital capture, 5 TIMERS/CCP, 53 GPIOs
- USB-OTG supporting both Host and Device functions and allows the implementation of Google Android ADK
- Comes programmed with Duinomite bootloader – even if you lack programmer tool you can program the board using the mini USB
- [UEXT connector](#) which allows many existing modules like RF, ZIGBEE, GSM, GPS to be connected
- two LEDs
- one BUTTONs
- RESET button
- mini USB connector is used which is common and used in most cell phones, so you do not have to buy other cables
- all PIC ports available on 0.1" connectors
- ICSP connector allows programming with [PIC-KIT3](#)
- Dimensions 87×54 mm (3.4×2.12")

1.2 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 PIC32MX795F512H 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

CHAPTER 2 SETTING UP THE PIC32-T795 BOARD

2. Introduction to the chapter

This section helps you set up the PIC32-T795 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

PIC32-T795 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 PIC32-T795, the following items are required:

- miniUSB to USB A cable
- Computer work station

Highly recommended items:

- Breadboard <https://www.olimex.com/Products/Duino/Breadboarding/BREADBOARD-1/>,
<https://www.olimex.com/Products/Duino/Breadboarding/BREADBOARD-MINI/>
- PIC32 compatible programmer/debugger. You can use our PIC-KIT3 for programming/debugging <https://www.olimex.com/Products/PIC/Programmers/PIC-KIT3/>
- Jumper wires for testing
<https://www.olimex.com/Products/Duino/Breadboarding/BREADBOARD-MINI/>

The breadboard helps you use the free pins at the bottom of the board with jumper wires without soldering. Also makes applying external supply easier.

Additionally a host-based software toolchain is required in order to program/debug the PIC32-T795 board.

2.3 Powering the board

The board is powered either by the mini USB or by the SUPPLY1 or SUPPLY2 line(when the board is mounted on the breadboard you might use the VCC and the VDD breadboard bus).

On powering the board PWR and LED2 LEDS turn on.

The board comes with preloaded Duinomite bootloader. For more information on Duinomite check the following links and documents:

<http://www.duinomite.com/>

<https://www.olimex.com/Products/Duino/Duinomite/DUINOMITE-MEGA/>

If you don't remove the bootlader the board comes with, when connected via the USB OTG the device should be recognized as a COMx. If it doesn't get recognized this means you lack the driver for your operating system.

2.4 Prebuilt software

On arrival the board has a Duinomite bootloader installed.

Connect the board to the computer work station (e.g. PC) via the USB OTG. Open the device manager and check which COM port the device initialized at. Launch your favorite terminal program at the COM port found at 115200 baud. Press “Enter” on your keyboard. Write “setup” command in the terminal.

For more comprehensive set of example and notes on the MM-Basic check the user manuals of the Duinomite boards.

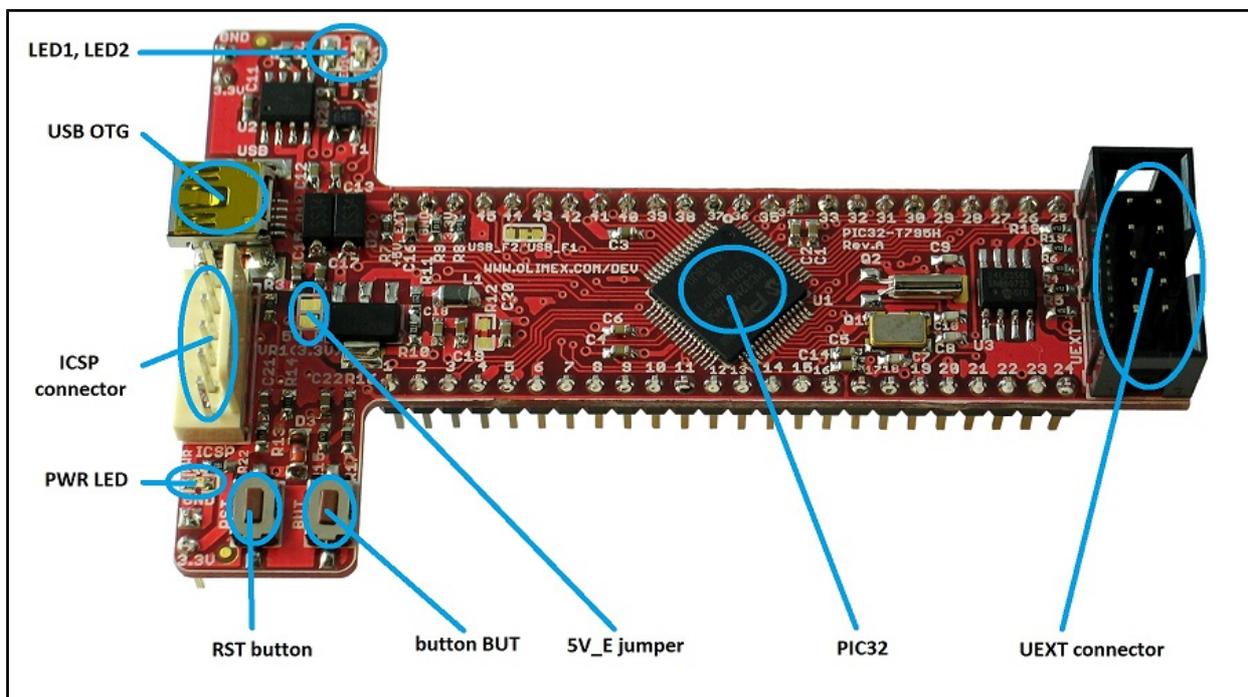
The board can be relatively easy configured for use with Piunguino IDE also. You would need to change the SMT jumper at the bottom of the board from RD8 (default) position to RD0. This is required since Pinguino and Duinomite bootloaders use different pins for the button required to enter bootloader mode. All files that might be required to change to Pinguino IDE are available at the PIC32-T795H's website.

CHAPTER 3 PIC32-T795 BOARD DESCRIPTION

3. Introduction to the chapter

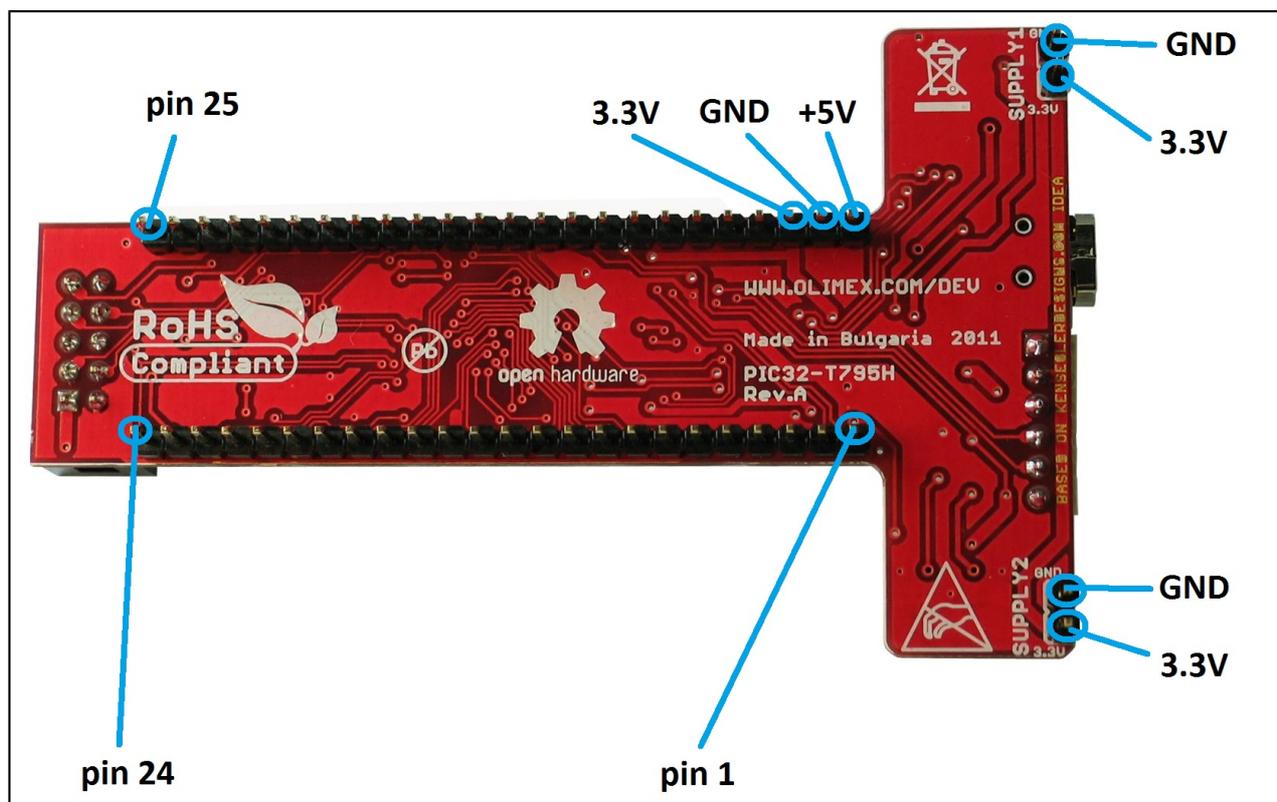
Here you get acquainted with the main parts of the board. Note the names used on the board differ from the names used to describe them. For the actual names check the PIC32-T795 board itself.

3.1 Layout (top view)



The T-shape design is based on idea by Ken Segler (www.KENSEGLERDESIGNS.com).

3.2 Layout (bottom view)



CHAPTER 4 THE PIC32MX795F512H MICROCONTROLLER

4. Introduction to the chapter

In this chapter is located the information about the heart of PIC32-T795 – its microcontroller. The information is a modified version of the datasheet provided by its manufacturers.

4.1 The microcontroller

PIC32-T795 board uses PIC32MX795F512H from Microchip Technology with these features:

High-Performance 32-bit RISC CPU:

- MIPS32® M4K® 32-bit core with 5-stage pipeline
- 80 MHz maximum frequency
- 1.56 DMIPS/MHz (Dhrystone 2.1) performance at zero Wait state Flash access
- Single-cycle multiply and high-performance divide unit
- MIPS16e™ mode for up to 40% smaller code size
- Two sets of 32 core register files (32-bit) to reduce interrupt latency
- Prefetch Cache module to speed execution from Flash

Microcontroller Features:

- Operating voltage range of 2.3V to 3.6V
- 512K Flash memory (plus an additional 12 KB of Boot Flash)
- 128K SRAM memory
- Pin-compatible with most PIC24/dsPIC® DSC devices
- Multiple power management modes
- Multiple interrupt vectors with individually programmable priority
- Fail-Safe Clock Monitor mode
- Configurable Watchdog Timer with on-chip Low-Power RC oscillator for reliable operation

Peripheral Features:

- Atomic SET, CLEAR and INVERT operation on select peripheral registers
- 8-channels of hardware DMA with automatic data size detection
- USB 2.0-compliant full-speed device and On-The-Go (OTG) controller:
 - Dedicated DMA channels
- 10/100 Mbps Ethernet MAC with MII and RMII interface:
 - Dedicated DMA channels
- CAN module:
 - 2.0B Active with DeviceNet™ addressing support
 - Dedicated DMA channels

- 3 MHz to 25 MHz crystal oscillator
- Internal 8 MHz and 32 kHz oscillators
- Six UART modules with:
 - RS-232, RS-485 and LIN 1.2 support
 - IrDA® with on-chip hardware encoder and decoder
- Four SPI modules
- Five I2C™ modules
- Separate PLLs for CPU and USB clocks
- Parallel Master and Slave Port (PMP/PSP) with 8-bit and 16-bit data, and up to 16 address lines
- Hardware Real-Time Clock and Calendar (RTCC)
- Five 16-bit Timers/Counters (two 16-bit pairs combine to create two 32-bit timers)
- Five Capture inputs
- Five Compare/PWM outputs
- Five external interrupt pins
- High-speed I/O pins capable of toggling at up to 80 MHz
- High-current sink/source (18 mA/18 mA) on all I/O pins
- Configurable open-drain output on digital I/O pins
- Debug Features:
 - Two programming and debugging Interfaces:
 - 2-wire interface with unintrusive access and real-time data exchange with application
 - 4-wire MIPS® standard enhanced Joint Test Action Group (JTAG) interface
 - Unintrusive hardware-based instruction trace
 - IEEE Standard 1149.2 compatible (JTAG) boundary scan
- Analogue Features:
 - 16-channel, 10-bit Analog-to-Digital Converter:
 - 1 Msps conversion rate
 - Conversion available during Sleep and Idle
 - Two Analog Comparators
 - 5V tolerant input pins (digital pins only)

CHAPTER 5 CONTROL CIRCUITY

5. Introduction to the chapter

Here you can find information about reset circuit and quartz crystal locations.

5.1 Reset

PIC32-T795 reset circuit includes R13 (4.7 k Ω), R14 (330 Ω), R66(560 Ω), C21(100 nF), D3 (1N4148), PIC32MX795F512H pin 7 (#MCLR) and a RESET button. The RESET is also connected to the ICSP pin 1.

5.2 Clock

8 MHz quartz crystal Q1 is connected to pins 39 and 40 of the processor.

Real time clock (RTC) Q2 is found at pins 47 and 48 of the processor.

IMPORTANT: If the board has a quartz crystal rotated at 45 degrees relative to the pads provided do not panic. This is normal. We have two types of such crystals – one of them requires 4 pads, the other only 2 pads. That is why we have provided 4 pads to be able to fit both crystals. All boards Olimex manufactures pass automatized optical inspection after assembly and obvious misplacements like these are impossible to occur.

CHAPTER 6 HARDWARE

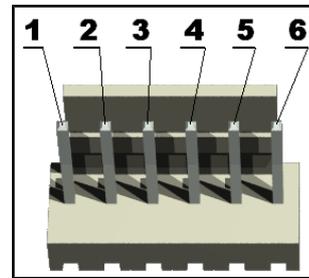
6. Introduction to the chapter

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

6.1 ICSP connector

Note that the ICSP connector mounted on the board is the one with the larger step – 100 mil.

ICSP connector			
Pin #	Signal Name	Pin #	Signal Name
1	RESET	4	PGED1
2	+3.3	5	PGEC1
3	GND	6	Not connected

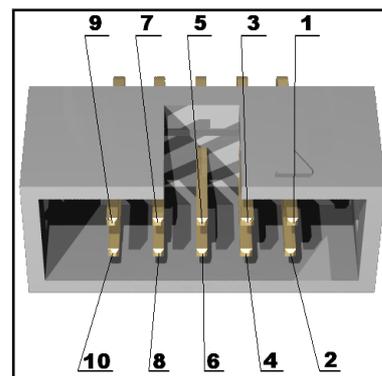


6.2 UEXT

PIC32-T795 board has UEXT connector and can interface Olimex's UEXT modules. For more information on UEXT please visit:

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

Pin #	Signal Name
1	+3.3V
2	GND
3	U2TX
4	U2RX
5	SCL1
6	SDA1



7	MISO
8	MOSI
9	SCK
10	#CS

6.3 Pinout of the row headers at the bottom

For your convenience the pads are named individually near each of them. Please take extra care about the numbering but consider that there might be offset.

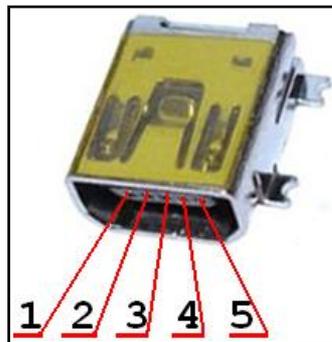
PIN#	MCU Pin # – Port Name (Used for)	PIN#	MCU Pin # - Port Name (Used for)
1	13 - RB3	25	46 - RD0 (PINGUINO_BOOT)
2	12 - RB4	26	52 - RD4
3	17 - RB6	27	53 - RD5
4	18 - RB7	28	54 - RD6
5	22 - RB9	29	55 - RD7
6	23 - RB10	30	58 - RF0
7	45 - RD11	31	59 - RF1
8	51 - RD3 (MOSI)	32	32 - RF5 (U2TX)
9	50 - RD2 (UEXT)	33	31 - RF4 (U2RX)
10	49 - RD1 (SCK)	34	21 - RB8
11	60 - RE0	35	29 - RB14
12	61 - RE1	36	28 - RB13
13	62 - RE2	37	30 - RB15 (LED1)
14	63 - RE3	38	4 - RG6
15	64 - RE4	39	5 - RG7 (USB_FAULT)
16	1 - RE5	40	6 - RG8
17	2 - RE6	41	8 - RG9
18	3 - RE7	42	11 - RB5 (VBUSON)
19	24 - RB11 (#CS)	43	14 - RB2

20	27 - RB12 (LED2)	44	15 - RB1 (PGEC1)
21	33 - RF3 (USB_ID)	45	16 - RB0 (PGED1)
22	42 - RD8 (DUINOMITE_BOOT)	3.3V	3.3V
23	43 - RD9 (SDA1)	GND	GND
24	44 - RD10 (SCL1)	+5V_ EXT	+5V

6.4 USB_OTG

USB-OTG can act makes possible to USB devices to the board. It makes the board act either as USB device or USB host.

Pin #	Signal Name
1	VBUS
2	D-
3	D+
4	USB_ID
5	GND



6.5 Jumper description

Most of the jumper configurations are printed with white print on the PCB for your convenience. Note that all of the jumpers on the board are SMD type. You will need basic soldering skills to be able to close those jumpers. If you have to separate already connected ones unsolder them and if needed cut the wire between the pads with cutter knife.



5V_E (optional)

In first few revisions of the board this jumper (when closed) was meant to enable 5V to the SUPPLY1 and SUPPLY2 lines (by default 3.3V) when closed but it also raised the processor's voltage way beyond the acceptable levels so the jumper was removed in latest revisions.

Please do not close 5V_E or you might damage the microcontroller on your PIC32-T795.

Default state is open.



RD8/RD0

Changes the default boot pin. If RD8 is selected starts with Duinomite bootloader. If RD0 is selected Pinguino bootloader.

The difference between the two bootloaders is the processor pin used for the button. Duinomite bootloader may be found at the Duinomite repository and Pinguino bootloader may be found in the Pinguino IDE folders.

Default positions is RD8.



EE_SCL1_E & EE_SDA1_E

These jumpers must be moved together. When open disconnect the EEPROM. If you use UEXT connector for something different than I2C better cut both these jumpers.

Default state is closed.

6.6 Additional hardware components

The components below are mounted on PIC32-T795 but are not discussed above. They are listed here for completeness:

user button + RST button

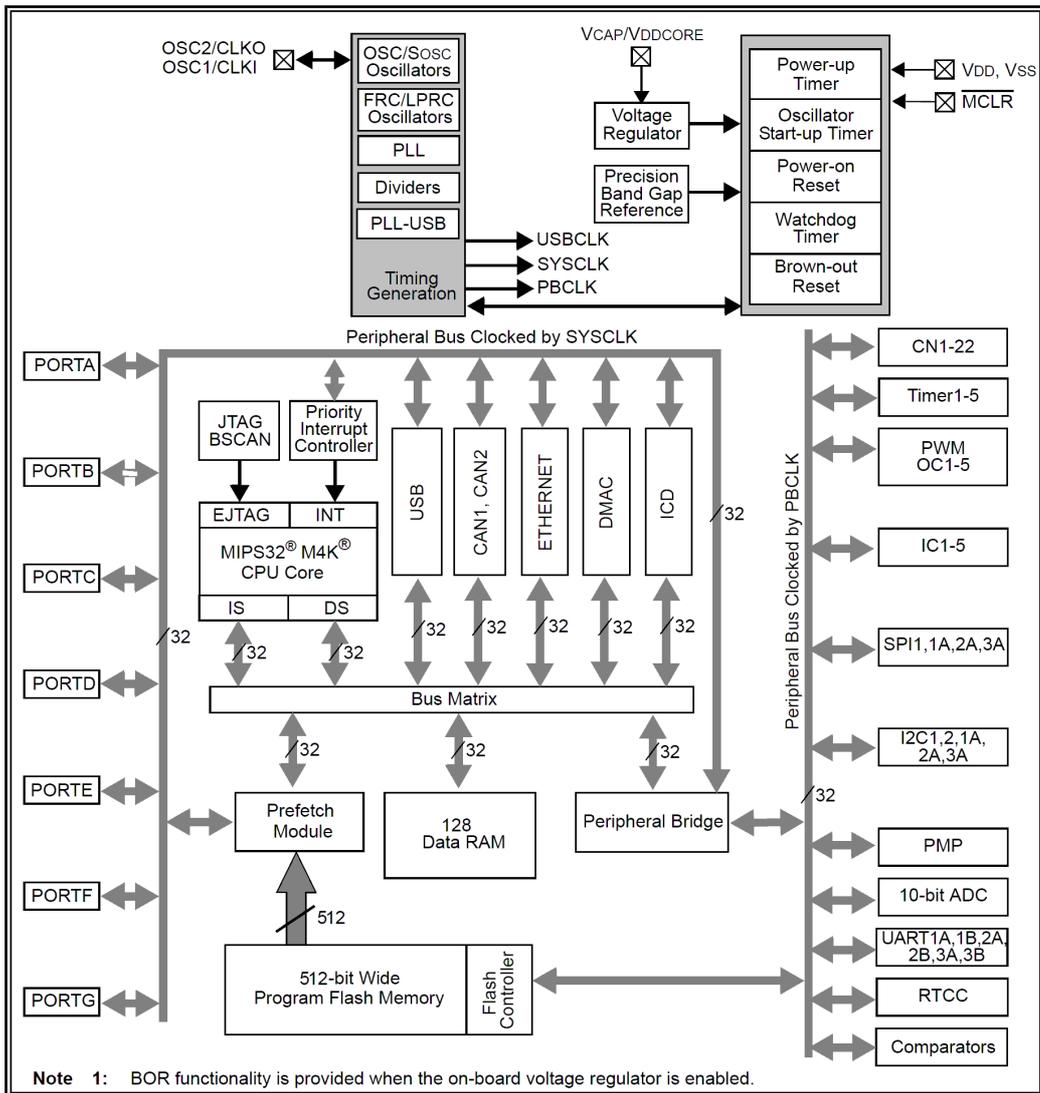
2 user LEDs + PWR LED

CHAPTER 7 MEMORY

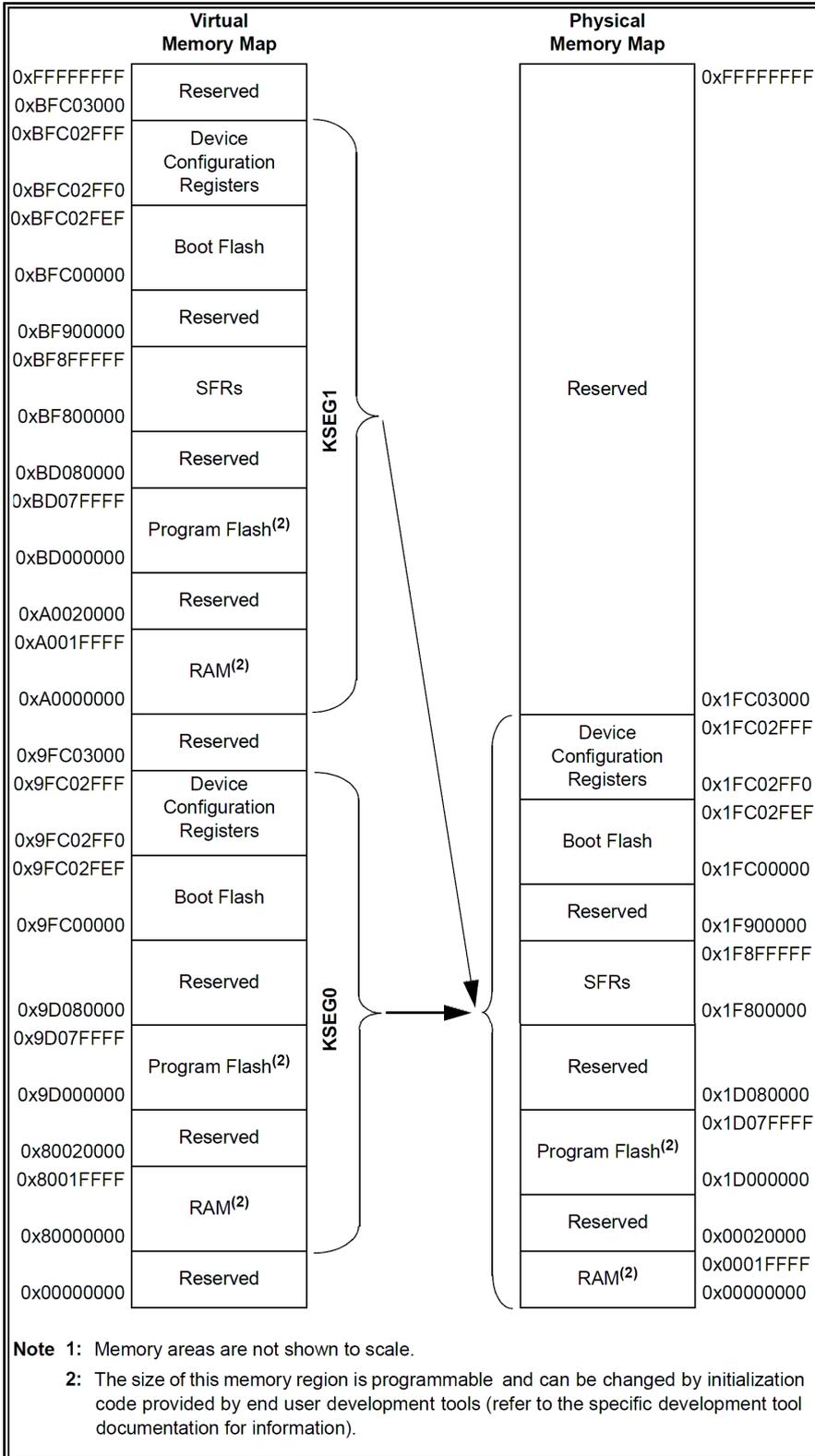
7. Introduction to the chapter

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 Microchip for one of a higher quality.

7.1 Block diagram of the processor



7.2 Memory map



CHAPTER 8 SCHEMATICS

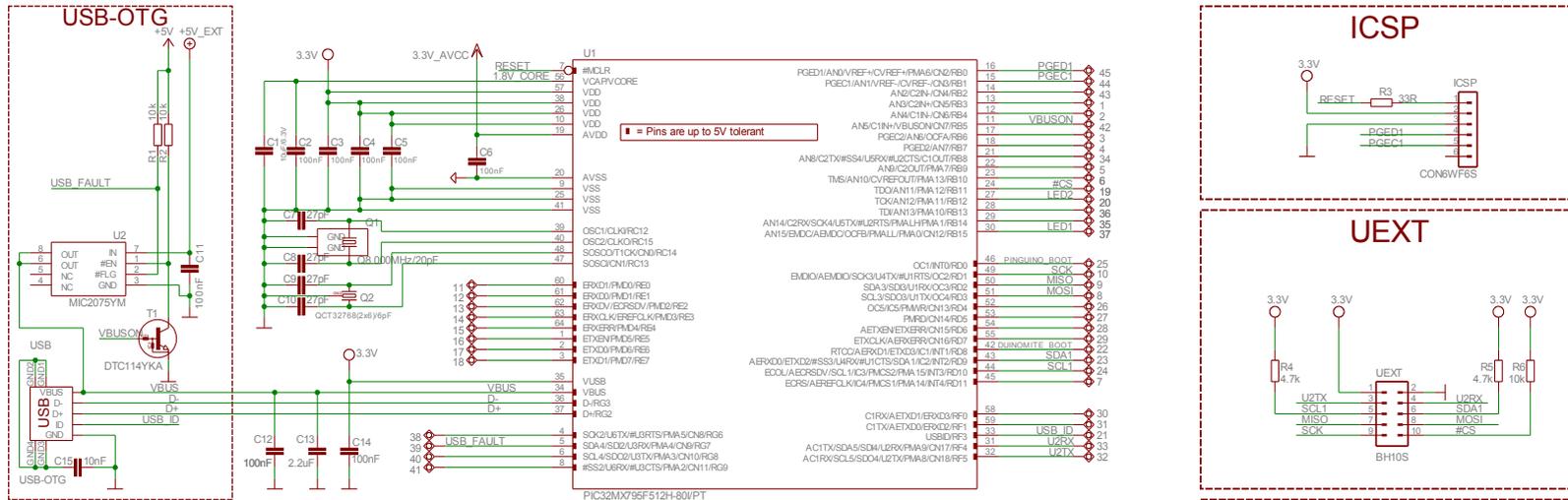
8. Introduction to the chapter

In this chapter are located the schematics describing logically and physically PIC32-T795.

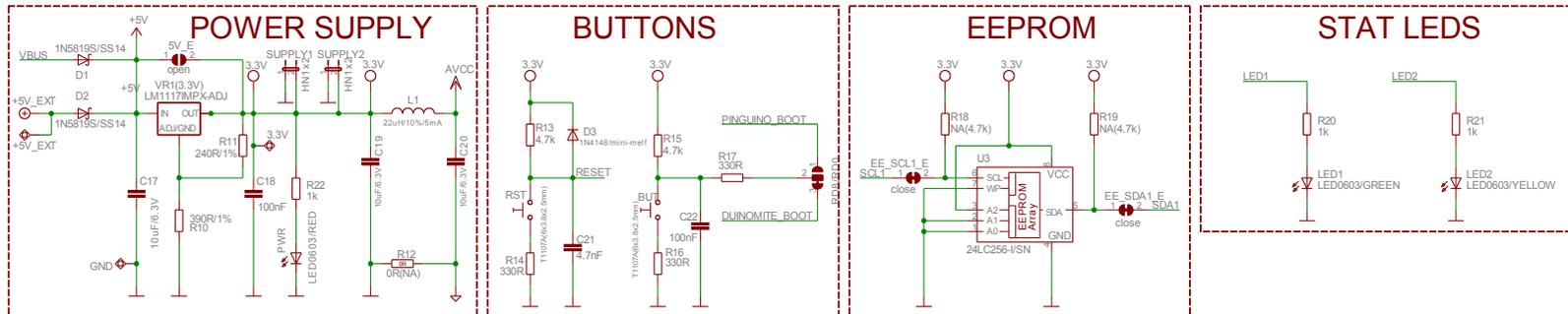
8.1 Eagle schematic

PIC32-T795 schematic is visible for reference here. You can also find them on the web page for PIC32-T795 at our site: <https://www.olimex.com/Products/Duino/PIC32/PIC32-T795/>. They are located in HARDWARE section.

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

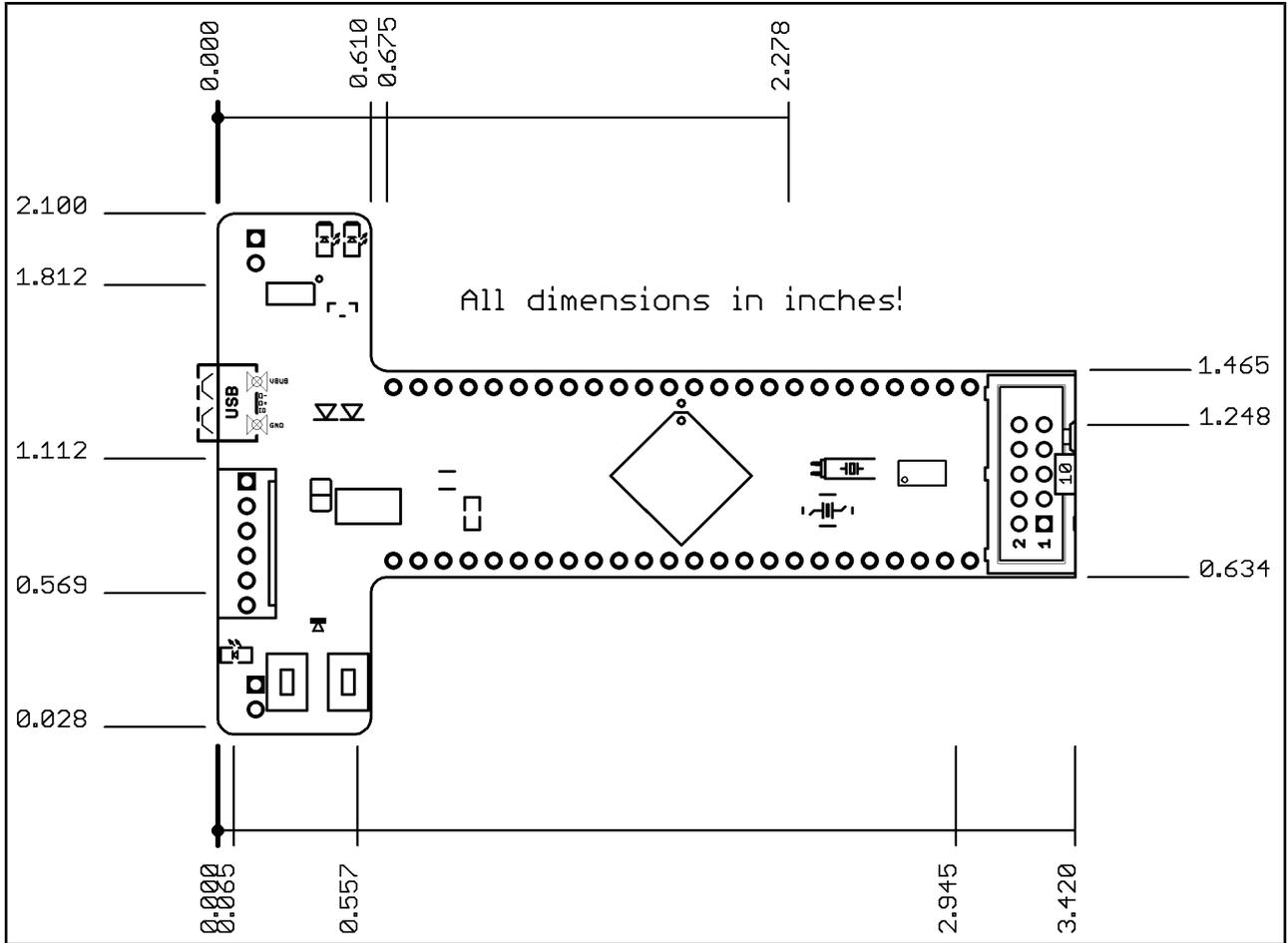


PIC32-T795H Rev.B
 Designed by: WWW.OLIMEX.COM/DEV
 BASED ON WWW.KENSEGLERDESIGNS.COM IDEA
 Released under Creative Commons Attribution-Share Alike 3.0 United States License



8.2 Physical dimensions

Note that all dimensions are in inches.



CHAPTER 9 REVISION HISTORY

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 Pages
A	Initial Creation	All
B	Improved the document formatting Fixed error about RD8/RD0 jumper Added info on how to switch between Pinguino and Duinomite mode Added links to the index Updated links	All
C	Fixed an error about pin #8 on page 15 Updated links	All
D	Updated the disclaimer Added a warning about the 5V_E jumper	17
E	Fixed wrong bottom view picture Added more info about Pinguino boot mode	10 8
F	Added a note about rotated quartz crystal	13

9.2 Web page of your device

The web page you can visit for more info on your device is <https://www.olimex.com/Products/Duino/PIC32/PIC32-T795/>. There you can find more info and some examples.

ORDER CODES:

PIC32-T795 – completely assembled and tested

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

PIC-KIT3 – for custom programming/debugging

How to order?

You can order directly using our web shop or via any of our distributors. The list of distributors is available here: <https://www.olimex.com/Distributors/>.

Check our webpage <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 shipping costs 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.