

# **STM32-P407 development board** **USER'S MANUAL**

Initial release, February 2012  
Designed by OLIMEX Ltd, 2011



All boards produced by Olimex LTD are ROHS compliant

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**Thank you for purchasing STM32-P407 development board assembled by  
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# CHAPTER 1

## OVERVIEW

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### 1. Introduction to the chapter

Thank you for choosing the STM32-P407 development board from Olimex! This document provides a User's Guide for the Olimex STM32-P407 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 STM32-P407 development board enables code development of applications running on the M4 CORTEX STM32F407ZGT6 microcontroller, manufactured by STMicroelectronics.

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### 1.1 Features

- STM32F407ZGT6 Cortex-M4 210DMIPS, 1MB Flash, 196KB RAM, 3×12-bit 2.4 MSPS A/D, 2×12-bit D/A converters, USB OTG HS and USB OTG FS, Ethernet, 14 timers, 3 SPI, 3 I2C, Ethernet, 2 CANs, 3 12 bit ADCs, 2 12 bit DACs, 114 GPIOs, Camera interface
- JTAG connector with ARM 2x10 pin layout for programming/debugging
- 512 KB fast external SRAM on board
- 4 Status LEDs
- Stereo Audio Codec CS4344
- CAN driver
- Temperature sensor
- Trimmer potentiometer
- Joystick for navigation
- 6610 LCD color 128x128 pixel TFT display
- SAMSUNG E700 VGA camera 640x480 color
- Tamper and Wakeup buttons
- 2 RS232 drivers and connectors
- 25 Mhz quartz crystal
- USB\_OTG
- USB\_HOST
- 100 Mbit Ethernet
- Mini SD/MMC card connector

- UEXT connector
  - Power Jack
  - RESET button and circuit
  - Power-on led
  - 3V battery connector
  - Extension port connectors for many of microcontrollers pins
  - PCB: FR-4, 1.5 mm (0,062"), soldermask, silkscreen component print
  - Dimensions: 160x116 mm (6.3x4.6")
- 

## 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 STM32F407ZGT6 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 STM32-P407 BOARD

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## 2. Introduction to the chapter

This section helps you set up the STM32-P407 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

STM32-P407 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 STM32-P407, the following items are required:

- 5 Vdc Power supply (or JTAG or SWD, or 5V TRACE, or 5V CAN, or 5V\_USB, depending on PWR\_SEL jumper position)
- SWD interface programmer

Note: additionally, the board can be programmed via JTAG interface but there are signals multiplexed with the LCD and the audio, so if using JTAG interface for programming you might need to implement a software mechanism to stop them or you might not be able to reprogram again.

You may use a pair of the following devices for this purpose:

- Any of Olimex's ARM-JTAG programmer/debugger (keeping in mind the note above)
- Any of Olimex's ARM-JTAG programmer/debugger + ARM-JTAG-SWD + Rowley CrossWorks

Also, a host-based software toolchain is required in order to program/debug the STM32-P407 board. There are also a number of ready IDEs available like IAR Embedded Workbench, Rowley CrossWorks, etc.

At the moment of writing this guide our ARM programmers/debuggers equipped with an ARM-

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JTAG-SWD work fine (out-of-the-box) with Rowley CrossWorks.

---

## **2.3 Powering the board**

Provide +5 V DC to the board's power jack, OR +5 V via the JTAG or TRACE connector (before providing the power set the PWR\_SEL jumper in the correct position)

On powering the board the PWR LED, the SATA4 LED and the display should turn on. The SATA1, SATA2 and SATA3 LEDs must start blinking consecutively.

If measuring the current consumption it should be around 30 mA.

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## **2.4 Prebuilt software**

On arrival the board has a basic demo installed which features test of the LEDs, the LCD, the joystick, the camera.

**IMPORTANT:** If you have only a programmer with JTAG interface and you need to turn off the peripherals using the JTAG signals press WKUP button! Pressing WKUP button will turn of those modules and will allow JTAG reprogramming.



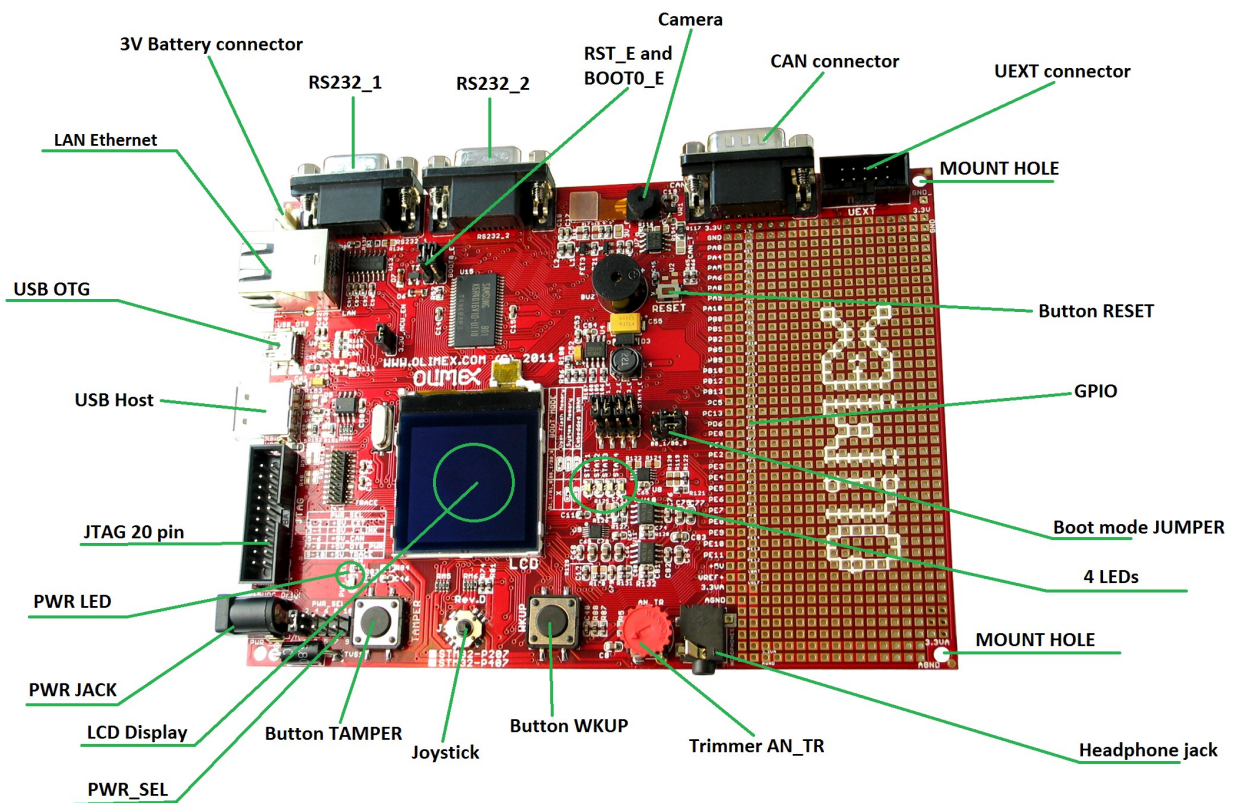
# CHAPTER 3

## STM32-P407 BOARD DESCRIPTION

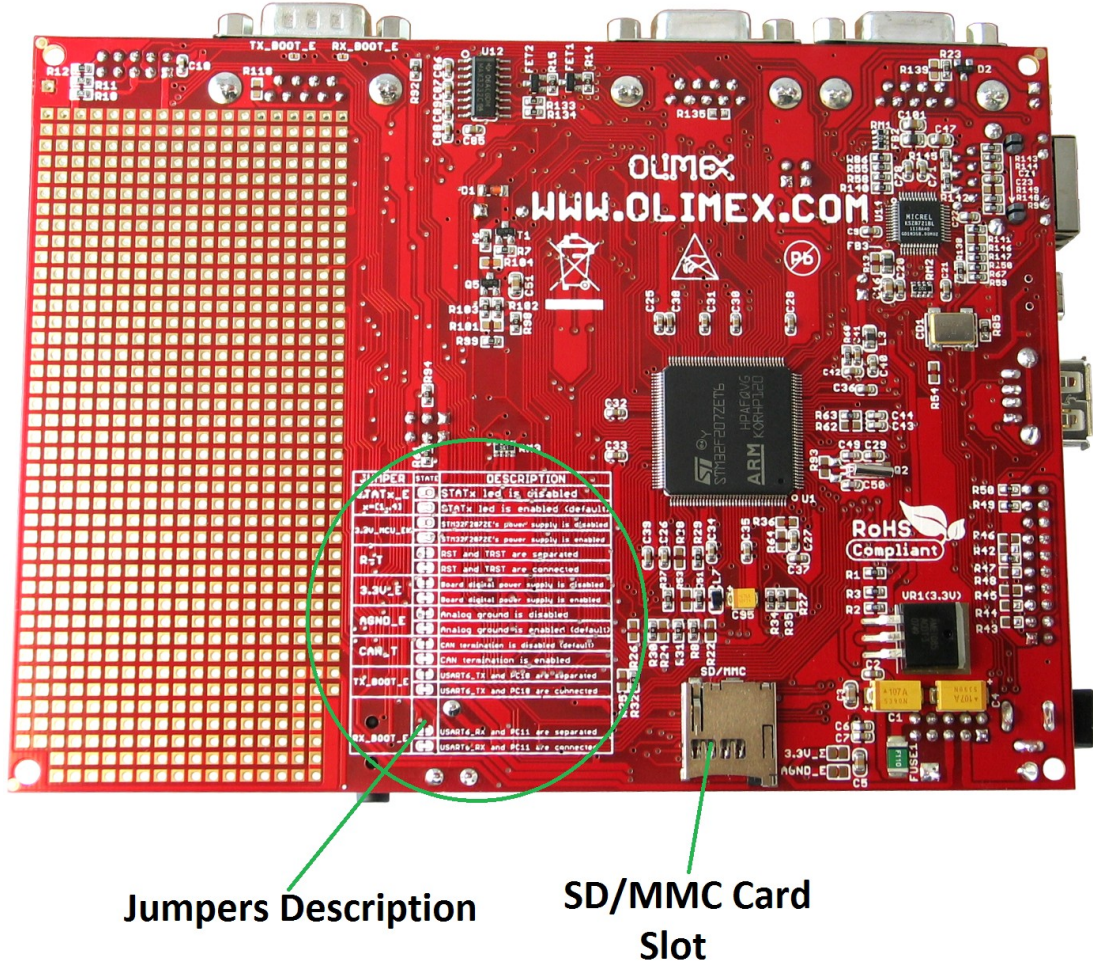
### 3. Introduction to the chapter

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 STM32-P407 board itself.

### 3.1 Layout (top view)



### 3.2 Layout (bottom view)



## CHAPTER 4

# THE STM32F407ZGT6 MICROCONTROLLER

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### 4. Introduction to the chapter

In this chapter is located the information about the heart of STM32-P407 – its microcontroller. The information is a modified version of the datasheet provided by its manufacturers.

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### 4.1 The microcontroller

- Core: ARM 32-bit Cortex™-M4 CPU with FPU, Adaptive real-time accelerator (ART Accelerator™) allowing 0-wait state execution from Flash memory, frequency up to 168 MHz, memory protection unit, 210 DMIPS/1.25 DMIPS/MHz (Dhrystone 2.1), and DSP instructions
  - Memories
    - 1 Mbyte of Flash memory
    - 192+4 Kbytes of SRAM including 64-Kbyte of CCM (core coupled memory) data RAM
    - Flexible static memory controller supporting Compact Flash, SRAM, PSRAM, NOR and NAND memories
  - LCD parallel interface, 8080/6800 modes
  - Clock, reset and supply management
    - 1.8 V to 3.6 V application supply and I/Os
    - POR, PDR, PVD and BOR
    - 4-to-26 MHz crystal oscillator
    - Internal 16 MHz factory-trimmed RC (1% accuracy)
    - 32 kHz oscillator for RTC with calibration
    - Internal 32 kHz RC with calibration
    - Sleep, Stop and Standby modes
    - VBATsupply for RTC, 20×32 bit backup registers + optional 4 KB backup SRAM
  - 3×12-bit, 2.4 MSPS A/D converters: 24 channels and 7.2 MSPS in triple interleaved mode
  - 2×12-bit D/A converters
  - General-purpose DMA: 16-stream DMA controller with FIFOs and burst support
  - Up to 17 timers: up to twelve 16-bit and two 32-bit timers up to 168 MHz, each with up to 4 IC/OC/PWM or pulse counter and quadrature (incremental) encoder input
  - Debug mode
    - Serial wire debug (SWD) & JTAG interfaces
-

- Cortex-M4 Embedded Trace Macrocell™
- Up to 114 I/O ports with interrupt capability
- Up to 15 communication interfaces
  - 3 × I2C interfaces (SMBus/PMBus)
  - 4 USARTs/2 UARTs (10.5 Mbit/s, ISO 7816 interface, LIN, IrDA, modem control)
  - 3 SPIs (37.5 Mbits/s), 2 with muxed full-duplex I2S to achieve audio class accuracy via internal audio PLL or external clock
  - 2 × CAN interfaces (2.0B Active)
  - SDIO interface
- Advanced connectivity
  - USB 2.0 full-speed device/host/OTG controller with on-chip PHY
  - USB 2.0 high-speed/full-speed device/host/OTG controller with dedicated DMA, on-chip full-speed PHY and ULPI
  - 10/100 Ethernet MAC with dedicated DMA: supports IEEE 1588v2 hardware, MII/RMII
- 8- to 14-bit parallel camera interface up to 54 Mbytes/s
- True random number generator
- CRC calculation unit
- 96-bit unique ID
- RTC: subsecond accuracy, hardware calendar

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://www.st.com/internet/com/TECHNICAL\\_RESOURCES/TECHNICAL\\_LITERATURE/DATASHEET/DM00037051.pdf](http://www.st.com/internet/com/TECHNICAL_RESOURCES/TECHNICAL_LITERATURE/DATASHEET/DM00037051.pdf)

If the Cortex M4 processor listed above seems like an overkill we have the same board offered with Cortex M3 one – STM32F207ZET6. The name of the board is STM32-P207. The table of comparison can be found below:

	STM32F207ZET6	STM32F407ZGT6
Maximum speed	120Mhz	168Mhz
Program memory	512KB	1024KB
Ram memory	132KB	192KB

## **CHAPTER 5**

### **CONTROL CIRCUITY**

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#### **5. Introduction to the chapter**

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

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#### **5.1 Reset**

STM32-P407 reset circuit includes R65 (10 K $\Omega$ ), R66(560  $\Omega$ ), C45(100 nF), STM32F407ZGT6 pin 25 (NRST) and a RESET button. The RESET is also connected to the proto area.

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#### **5.2 Clock**

25 MHz quartz crystal Q1 is connected to pins 23 and 24 of the processor.

Real time clock (RTC) Q2 is found at pins 8 and 9 of the processor.

## CHAPTER 6

### HARDWARE

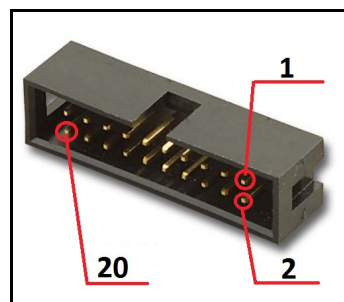
#### 6. Introduction to the chapter

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

#### 6.1 JTAG connector

The 20 pin JTAG connector provides the interface for JTAG or/and SWD/TRACE programming/debugging. It is advisable to use SWD/TRACE interface programmers.

JTAG/SWD interface			
Pin #	Signal Name	Pin #	Signal Name
1	+3.3V	11	+3.3 V
2	+3.3V	12	GND
3	TRST/SPI1_MISO	13	TDO/I2S3_CK
4	GND	14	GND
5	PGCTDI/I2S3_WS	15	RST
6	GND	16	GND
7	TMS	17	+5V_J-LINK
8	GND	18	GND
9	TCK	19	+5V_J-LINK
10	GND	20	GND



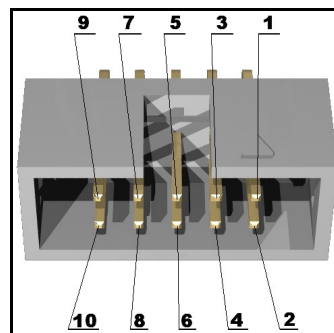
TRACE interface			
Pin #	Signal Name	Pin #	Signal Name
1	+3.3V	11	+5V_TRACE
2	TMS	12	TEMP_ALERT
3	GND	13	+5V_TRACE
4	TCK	14	USB_HS_VBUSON
5	GND	15	GND
6	TD0/I2S3_CK	16	DCMI_D4
7	Not connected	17	GND
8	TDI/I2S3_WS	18	DCMI_D6
9	GND	19	GND
10	RST	20	DCMI_D7

## 6.2 UEXT

STM32-P407 board has UEXT connector and can interface Olimex's UEXT modules. For more information on UEXT please visit:

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

Pin #	Signal Name
1	+3.3V
2	GND
3	DCMI_D0/USART6_TX
4	USART6_RX

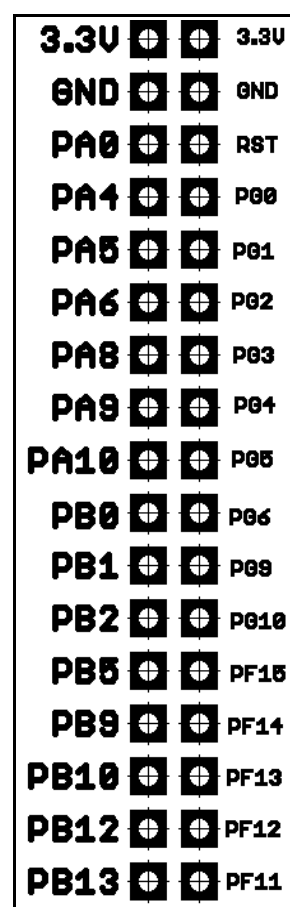


5	SOFTWARE_SCL
6	SOFTWARE_SDA
7	SD_D3/USART3_RX/SPI3_MISO
8	SD_CLK/SPI3_MOSI
9	SD_D2/USART3_TX/SPI3_SCK
10	STAT3/CS_UEXT

### 6.3 Pads on the proto area

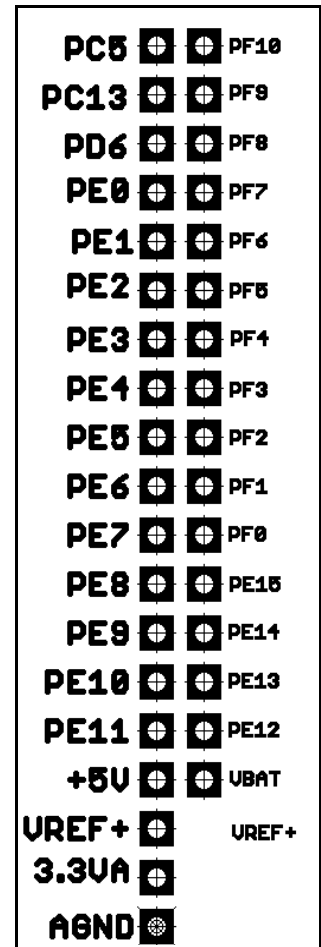
For your convenience the pads are named individually near each of them. Please take extra care about the numbering but consider that there might be offset.

PAD #	Signal Name	PAD#	Signal Name
PA0	BUT_WKUP	RST	RST
PA4	DCMI_HSYNC	PG0	A10
PA5	SPI1_SCK	PG1	A11
PA6	DCMI_PIXCLK	PG2	A12
PA8	MCO1	PG3	A13
PA9	OTG_FS_VBUS	PG4	A14
PA10	DCMI_D1	PG5	A15
PB0	LCD_BL	PG6	RIGHT(JOYSTICK)
PB1	BUZ	PG9	USART6_RX
PB2	CAM_ENB	PG10	SOFT_SCL
PB5	I2S3_SD	PF15	A9
PB9	CAN1_TX	PF14	A8
PB10	USB_FS_FAULT	PF13	A7
PB12	OTG_HS_ID	PF12	A6
PB13	OTG_HS_VBUS	PF11	CAM_RST



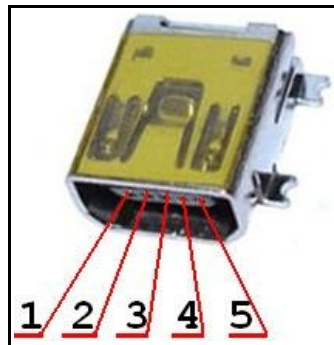


<b>PC5</b>	ETH_RMII_RXD1	<b>PF10</b>	ETH_RXER
<b>PC13</b>	BUT_TAMPER	<b>PF9</b>	SSTAT4/CAM_PWR
<b>PD6</b>	LCD_CS	<b>PF8</b>	STAT3/CS_UEXT
<b>PE0</b>	/BLE	<b>PF7</b>	STAT2/CAN_CTRL
<b>PE1</b>	/BHE	<b>PF6</b>	STAT1
<b>PE2</b>	TEMP_ALERT	<b>PF5</b>	A5
<b>PE3</b>	USB_HS_VBUSON	<b>PF4</b>	A4
<b>PE4</b>	DCMI_D4	<b>PF3</b>	A3
<b>PE5</b>	DCMI_D6	<b>PF2</b>	A2
<b>PE6</b>	DCMI_D7	<b>PF1</b>	A1
<b>PE7</b>	D4	<b>PF0</b>	A0
<b>PE8</b>	D5	<b>PE15</b>	D12
<b>PE9</b>	D6	<b>PE14</b>	D11
<b>PE10</b>	D7	<b>PE13</b>	D10
<b>PE11</b>	D8	<b>PE12</b>	D9
<b>+5V</b>	+5V DC	<b>VBAT</b>	VBAT



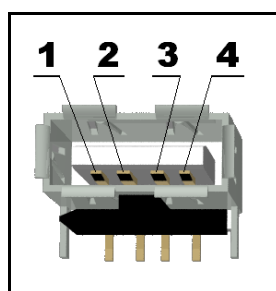
### 6.4 USB\_OTG

Pin #	Signal Name
1	+5V
2	D-
3	D+
4	OTG_HS_ID
5	GND



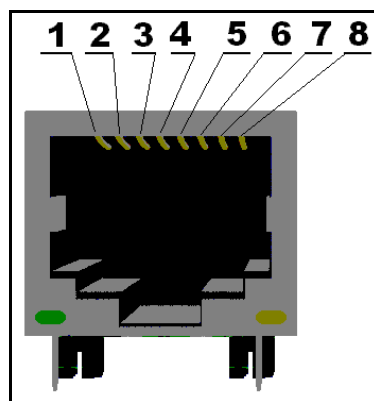
## 6.5 USB HOST

PIN#	SIGNAL NAME
1	+5 V
2	USB_HOST_D-
3	USB_HOST_D+
4	GND



## 6.6 LAN connector

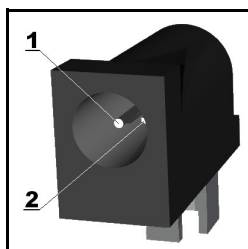
PIN#	SIGNAL NAME
1	TX+
2	TX-
3	VDD
4	NOT CONNECTED
5	NOT CONNECTED
6	VDD
7	RX+
8	RX-



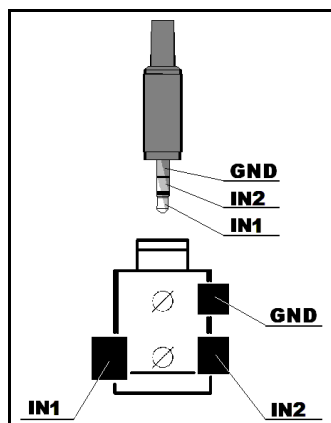
LED	Color	Usage
Right	Green	Link status
Left	Yellow	Activity status

### 6.7 PWR Jack

Pin #	Signal Name
1	Power Input
2	GND

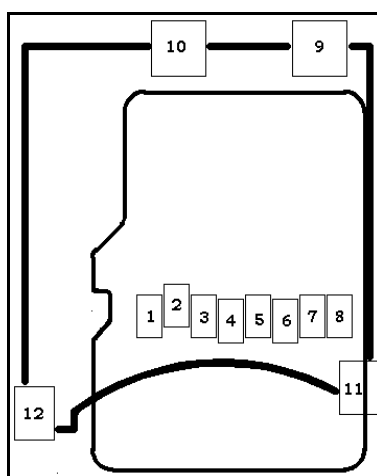


### 6.8 Headphones connector



### 6.9 SD/MMC slot

Pin #	Signal Name
1	DAT2
2	DAT3/CS
3	CMD/DI
4	VDD
5	CLK/SCLK

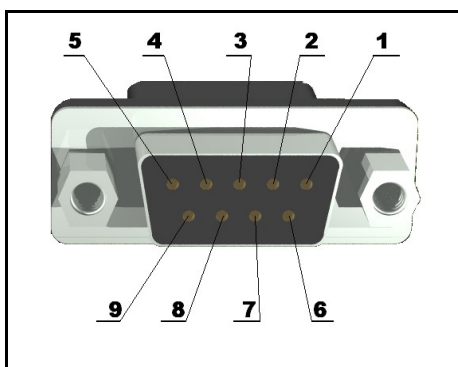


6	VSS
7	DAT0/D0
8	DAT1

### 6.10 RS232\_1

RS232\_1 is located on USART6/SPI3 line. Check the jumper configuration.

Pin #	Signal Name
1	Not Connected
2	T1OUT
3	R1IN
4	Not Connected
5	GND
6	Not Connected
7	CTS
8	RTS
9	Not Connected

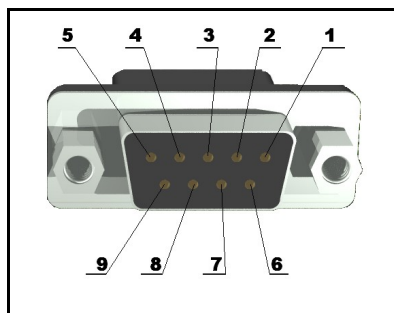


### 6.11 RS232\_2

RS232\_2 is located on USART3 (processor pins D13 – D14, A17 – A16)

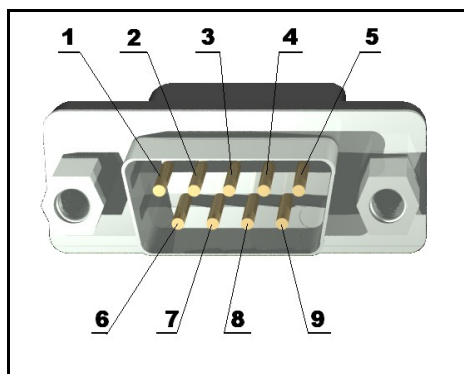
Pin #	Signal Name
1	Not connected

2	T1OUT
3	R1IN
4	Not connected
5	GND
6	Not connected
7	CTS
8	RTS
9	Not connected



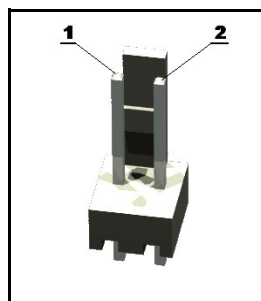
### 6.12 CAN connector

Pin#	Signal name
1	Not connected
2	CANL
3	VSS
4	Not connected
5	VSS
6	GND
7	CANH
8	Not connected
9	+5V_CAN



## 6.13 Battery connector

Pin #	Signal Name
1	VBAT
2	GND



## 6.14 Jumper description

Most of the jumper configurations are printed with white print on the PCB for your convenience.

### PWR\_SEL

On the setting of this jumper depends the way we power the board. There is a table printed on the board with the positions. You can check the table below also. Position 1-2 is the one at the PWR connector side.

PWR_SEL	
1 - 2	+5V_EXT
3 - 4	+5V_J-LINK
5 - 6	+5V_CAN
7 - 8	+5V_USB_OTG
9 - 10	+5V_TRACE

**Default position is 3-4.**

**STAT1\_E, STAT2\_E, STAT3\_E, STAT4\_E**

Those 4 jumpers control whether the LEDs are powered(closed) or not(open).

**Default state is closed.**

---

**BOOT0\_E**

Connected to pin 138 (BOOT0/VPP), enables boot if closed.

**Default state is open.**

---

**RST\_E**

Controls the RST on the RS232\_1. If closed is present. Default state is not present.

**Default state is open.**

---

**B1\_1/B1\_0, B0\_1/B0\_0**

These jumpers should be moved together and control the camera being powered.

**Default state is B1\_0, B0\_0 (camera powered).**

---

**3.3V\_MCU\_EN**

When closed enables the power supply on the STM32F207ZET.

**Default state is closed.**

---

**TX\_BOOT\_E**

If closed separates USART6\_TX and PC10.

**Default state is open.**

---

**RX\_BOOT\_E**

If closed separates USART6\_RX and PC11.

**Default state is open.**

---

**3.3V\_E**

Board's digital power supply is disabled if open.  
Enabled if closed.

**Default state is open.**

---

**AGND\_E**



Analog GND is disabled if open.  
If closed Analog GND is enabled.

**Default state is closed.**

---

---



#### **R-T**

RST and TRST are separated if open.

RST and TRST are connected if closed.

Refer to the schematic near the JTAG connector for how this jumper influences the JTAG programming of the board.

**Default state is open.**

---



#### **CAN\_T**

Can termination is disabled if open.

**Default state is open.**

---

## **6.15 LCD Display with backlight**

replica of Nokia 6610 color display 128x128 pixels

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## **6.16 VGA Color Camera**

640x480 pixels (0.3 mega pixel) Samsung 700 camera + connector

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## **6.17 Additional hardware components**

The components below are mounted on STM32-P407 but are not discussed above. They are listed here for completeness:

**Joystick**

**Temperature sensor**

**Audio out**

**Trimmer**

**Buzzer**

**Additional memory**

**2 buttons + RST button**

**4 status LEDs + PWR LED**

## **CHAPTER 7**

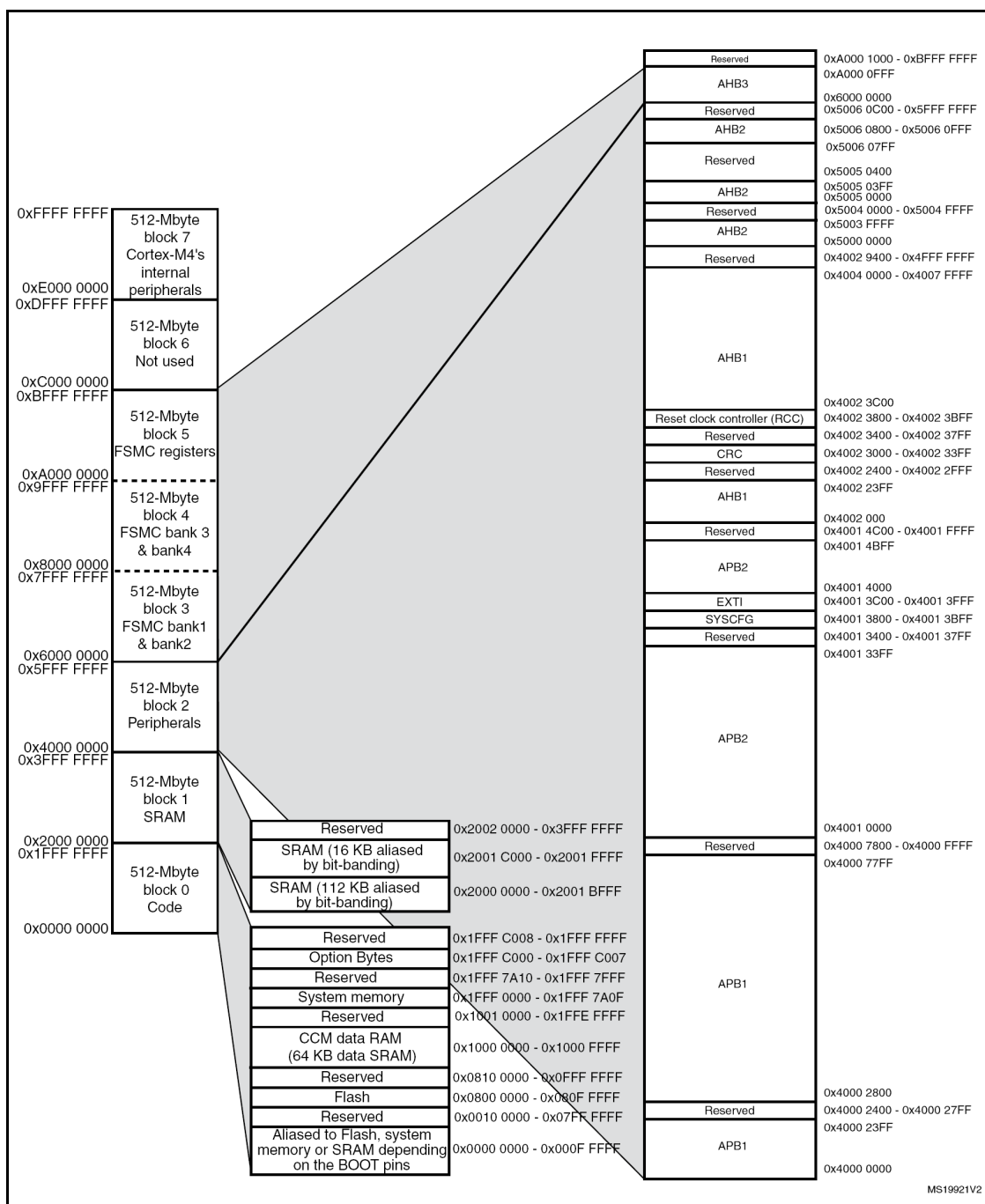
### **MEMORY**

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#### **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 STMicroelectronics for one of higher quality.

## 7.1 Memory map



## CHAPTER 8

### SCHEMATICS

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#### 8. Introduction to the chapter

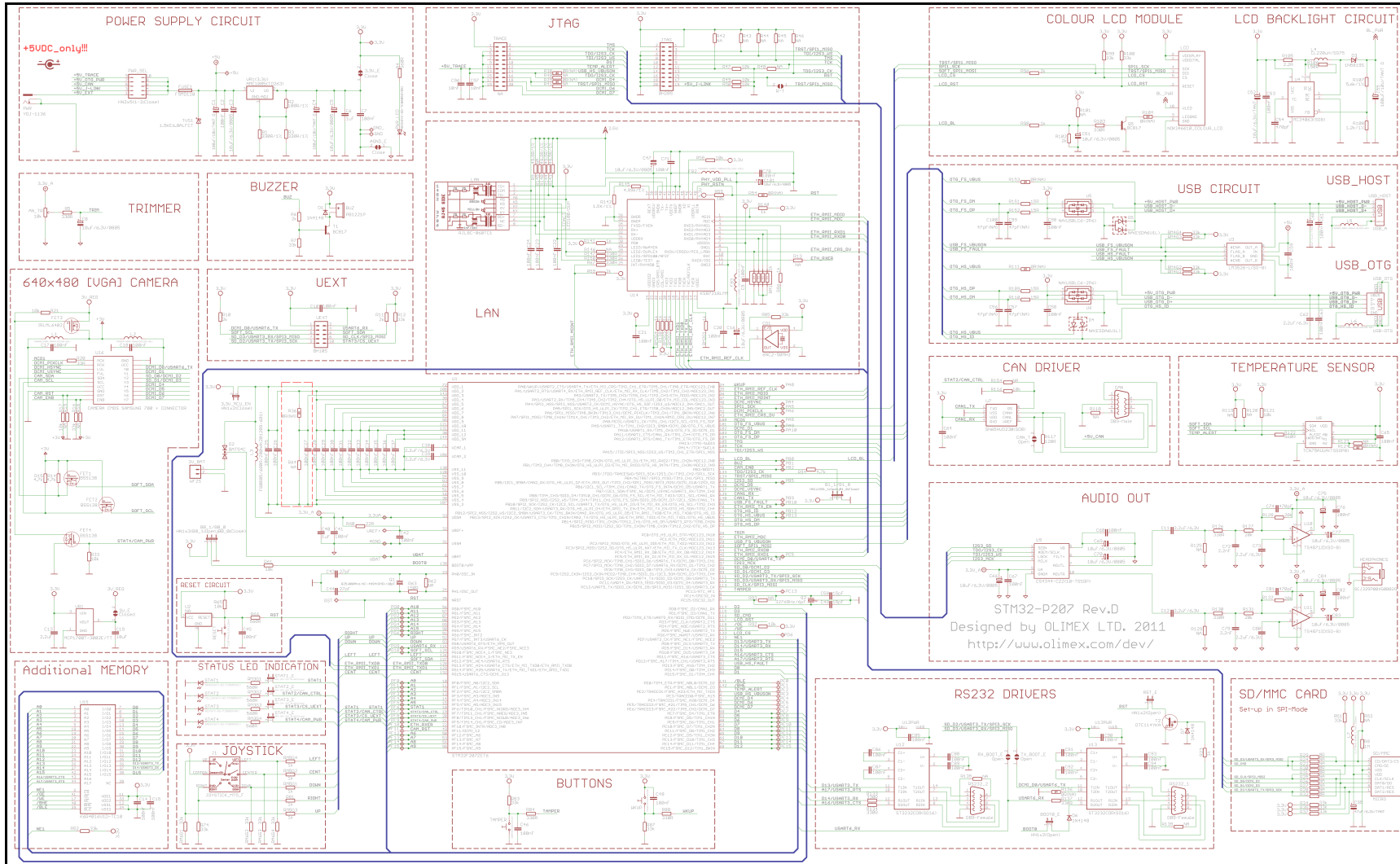
In this chapter are located the schematics describing logically and physically STM32-P407.

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#### 8.1 Eagle schematic

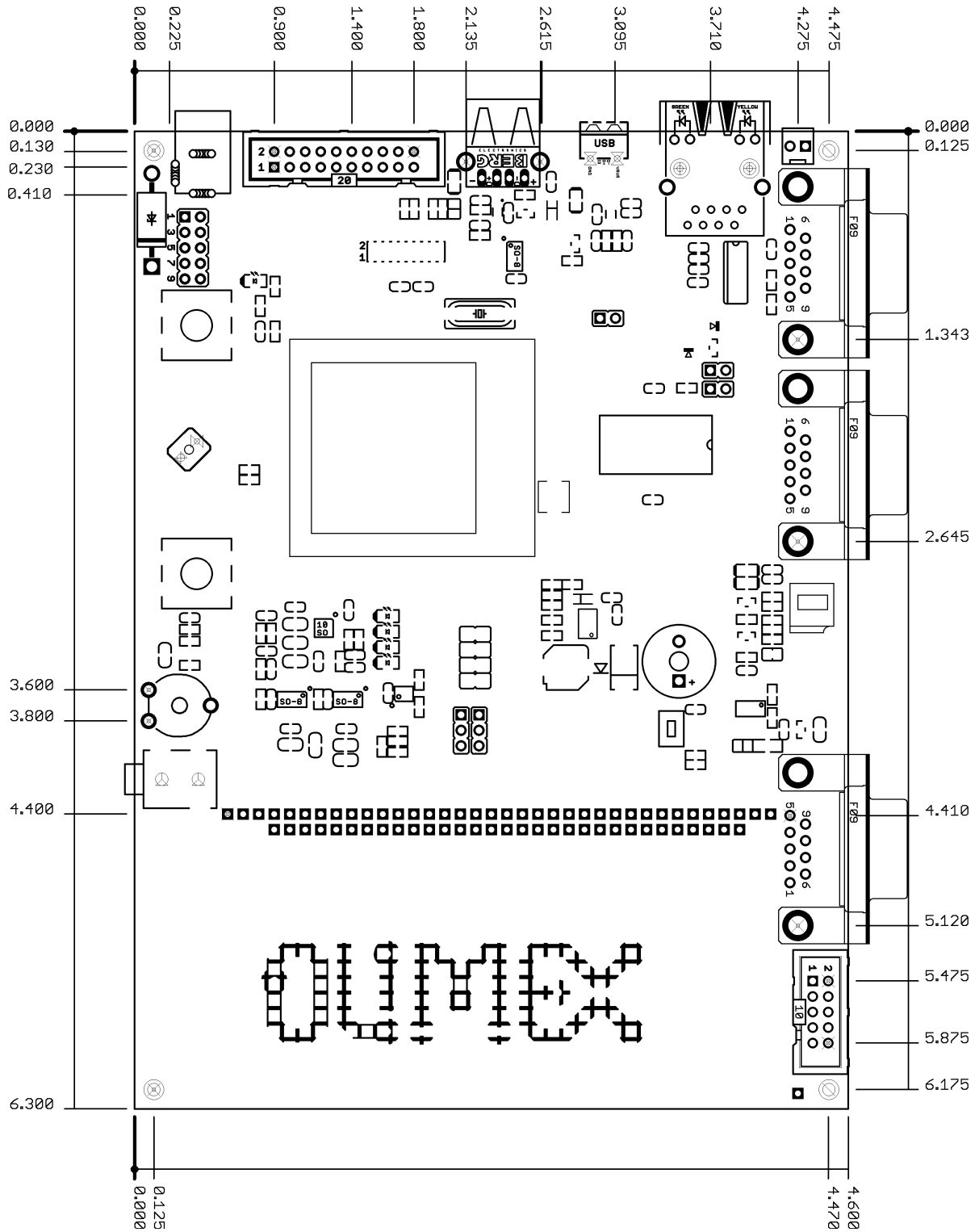
STM32-P407 schematic is visible for reference here. You can also find them on the web page for STM32-P407 at our site: <http://www.olimex.com/dev/stm32-P407.html>. They are located in HARDWARE section.

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



### 8.2 Physical dimensions

Note that all dimensions are in inches.



## CHAPTER 9

### REVISION HISTORY

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#### 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.

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#### 9.1 Document revision

Revision	Changes	Modified Pages
A	Initial Creation	All

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#### 9.2 Web page of your device

The web page you can visit for more info on your device is <http://www.olimex.com/dev/stm32-P407.html>. There you can find more info and some examples.

#### ORDER CODES:

**STM32-P407** - completely assembled and tested

**ARM-USB-TINY** - for custom programming/debugging

**ARM-USB-TINY-H** - for custom programming/debugging

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

**ARM-JTAG-SWD** – SWD adapter for our ARM-JTAG programmers

How to order?

You can order to us directly or by any of our distributors.

**Check our webpage <http://www.olimex.com/> for more info.**

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