

A13-OLinuXino-MICRO

Open-source single-board
mini-computer

USER'S MANUAL

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Designed by OLIMEX Ltd, 2013



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The software is released under GPL.

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CHAPTER 1: OVERVIEW

1. Introduction to the chapter

Thank you for choosing the OLinuXino single board computer from Olimex! This document provides a user's guide for the Olimex OLinuXino 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 OLinuXino development board enables code development of applications running on the microcontroller A13, manufactured by Allwinner Technology from China.

OLinuXino is an open-source, open-hardware project and all documentation is available to the customer.

1.1 Features

- A13 Cortex A8 processor at 1GHz, 3D Mali400 GPU
- 256 MB RAM (128Mbit x 16)
- 5VDC input power supply, noise immune design
- 1 USB Host
- 1 USB OTG which can power the board
- SD-card connector for booting Linux or Android image
- VGA video output – 800 x 600 maximum resolution
- LCD signals available on connector so you still can use LCD if you disable VGA/HDMI
- Audio output
- Microphone input pads (no connector)
- 1 User key
- 4 Mount holes
- UEXT connector for connecting additional UEXT modules like Zigbee, Bluetooth, relays, etc
- GPIO connector with 68/74 pins and these signals : 17 for adding NAND flash; 22 for connecting LCDs; 20+4 including 8 GPIOs which can be input, output, interrupt sources; 3x I2C; 2x UARTs; SDIO2 for connectinf SDcards and modules; 5 system pins: +5V, +3.3V, GND, RESET, NMI
- (Optional low cost 7" or 4.8" LCD with/without touchscreen)

1.2 Target market and purpose of the board

The boards from the OLinuXino family are powerful and easy to setup. They are suitable for embedded programming enthusiasts, Linux and Android gadget fans and also professionals (since its low cost makes it very good solution for application orientated embedded systems). The main usage of the board is software embedded development without the urge of understanding perfectly the hardware.

The strong points of the boards are the processor speed, the mobility of the board and the low ratio price to productivity.

A13-OLinuXino-MICRO aims at the lowest possible cost while maintaining the key OLinuXino features. It is suitable for cases when a number of boards are used. It is suitable for different Linux distributions.

Customers have full access to the technical documentation of the board. The software is released under General Purpose License and the board is considered open-hardware.

1.3 Board variants

There are two major board variants. According to the names: A13-OLinuXino and A13-OLinuXino-MICRO.

The base model has also two flavors: A13-OLinuXino and A13-OLinuXino-MICRO-WIFI. The first one is the base model that goes without any operating system image on board, while the second has two additional components – a WIFI module on the board and NAND memory with stored Android image.

The A13-OLinuXino-MICRO is the other less populated but cheaper board in the family. It also lacks Android out-of-the-box.

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 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 A13 – Allwinner processor
- 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 provides the schematics
- Chapter 8 contains the revision history, useful links and support information

CHAPTER 2: SETTING UP THE OLINUXINO BOARD

2. Introduction to the chapter

This section helps you set up the OLinuXino 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

OLinuXino 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 A10s-OLinuXino-Micro optimally one or more additional items may be used. They might be generally placed in three categories:

Required - items that are needed in order to achieve minimum functionality;

Recommended – items that is good to have in order to be able to interact with the most important of the features of the board;

Required items:

- 5V, 5W required (5V @ 1A) – for optimal power
- LCD (preferably with touchscreen panel) display for the LCD_CON OR TV monitor with RGB port (or suitable connector)
- USB hub (for splitting the USB) – else you will be unable to connect your USB devices
- A USB mouse – if you use touchscreen LCD you might skip the mouse
- A Micro SD card with Linux image – you can download and upload the image on any 2GB or bigger Micro SD card – the image can be downloaded from the wiki article (<https://www.olimex.com/wiki/A13-OLinuXino-MICRO>)

Recommended items:

- USB keyboard – for convenience with text input
- USB-SERIAL-CABLE-F – for serial communication with UART1 connector (note that it has to be female)
- USB-MINI-CABLE – for connecting with the USB OTG and being able to firmware update to power A13-OLinuXino-MICRO
- Wireless internet connectivity or USB modem – for browser access and access to the Android market

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

SY0605E - power supply adapter 5V/1A for A13-OLinuXino-MICRO

USB-SERIAL-CABLE-F - USB serial console cable female

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

A13-OLinuXino-MICRO-SD - SD card with ready and tested Debian –

<https://www.olimex.com/Products/OLinuXino/A13/A13-OLinuXino-MICRO-SD/>. Note the cards for A13-OLinuXino and A13-OLinuXino-WIFI

A 10.1"; 7" and 4.3" LCD displays with optional touch screen panels are available for purchase also:

<https://www.olimex.com/Products/OLinuXino/A13/A13-LCD10/>

<https://www.olimex.com/Products/OLinuXino/A13/A13-LCD10TS/>

<https://www.olimex.com/Products/OLinuXino/A13/A13-LCD7/>

<https://www.olimex.com/Products/OLinuXino/A13/A13-LCD7-TS/>

<https://www.olimex.com/Products/OLinuXino/A13/A13-LCD43TS/>

Note that by the time of updating this manual the 10 inch display isn't still properly supported under all OLinuXino boards but it is relatively easy to add such support and once we have tested all configurations such images would be posted.

2.3 Powering the board

There are two possible ways of powering A13-OLinuXino-MICRO – via external supply using the power jack, or via the USB OTG connector. Depending on your preferred way of powering A13-OLinuXino-MICRO you might need additional hardware.

The preferred way of powering board is via the PWR jack with 5Vdc with a power of 5W (e.g. 5Vx1A). This will make the board fully powered and able to power most peripherals connected to it.

The board can also be powered by the USB OTG connector (mini USB standard) but the power provided by a standard USB is not enough to power a lot of peripherals - either a LCD (connected to the LCD_con) or USB peripherals (connected to the USB type B) but not to power both. If you still wish to use USB power there are is the option to use adapter 2xUSB type A to 1xUSB type mini.

If you have a standard LCD display connected to LCD_con, Android and WIFI running the typical consumption is around 450mA depending on the current load. While the board is in stand-by mode it consumes a minimum of 70mA. All the three approximate values above were taken when I applied 5V to the board.

For the European customers we sell a power supply adapter 5V/0.5A – **SY0605E**. We also sell USB type A to USB mini cables if you lack such.

The needed username/password combination for the Linux on the Olimex Linux distribution is root/password.

2.4 Prebuilt software

Note that the A13-OLinuXino and A13-OLinuXino-MICRO lack NAND memory and WIFI and there isn't OS uploaded on the shipped boards.

So far we have been successful in using Debian booting from SD card with both of the boards. The same can't be said for booting Android from SD card.

2.5 Software instructions and available SD card images

This can vary depending on what the owner of the board want to achieve. Good collection on information on the subject can be found at the following WIKI articles:

<https://www.olimex.com/wiki/A13-OLinuXino-MICRO>

<https://www.olimex.com/wiki/A13-OLinuXino>

Other good sources are:

1) the Wordpress site where a lot of side projects are published and explained:

<http://olimex.wordpress.com/?s=a13+micro>

2) the Olimex forum in its A13 section

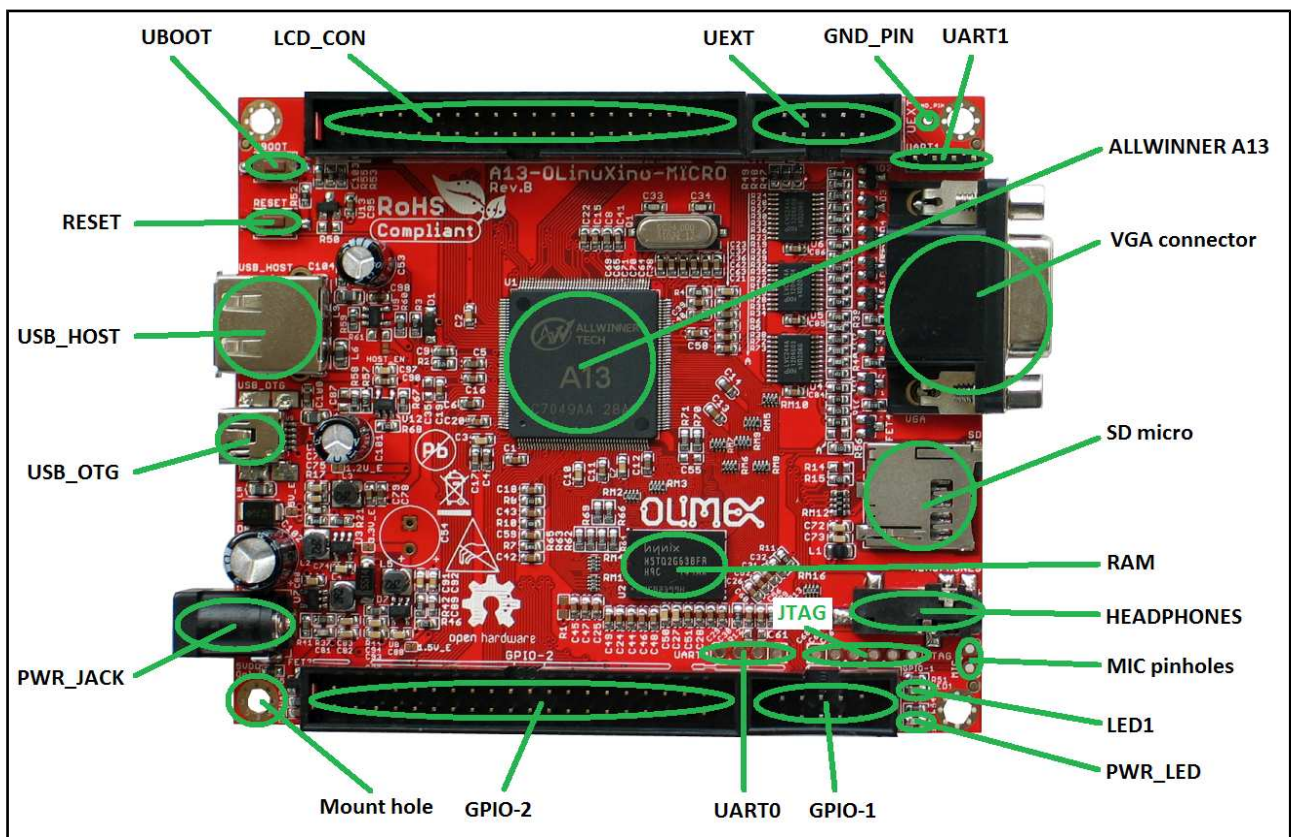
<https://www.olimex.com/forum/>

CHAPTER 3: A13-OLinuXino-MICRO 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 A13-OLinuXino-MICRO board itself.

3.1 Layout (top view)



The picture above shows the initial revision B of A13-OLinuXino-MICRO.

CHAPTER 4: THE ALLWINNER A13 MICROCONTROLLER

4. Introduction to the chapter

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

4.1 The microcontroller

- CPU/GPU
 - ARM Cortex-A8 Core
 - 32KB D-Cache/ 32KB I-Cache
 - 256KB L2 Cache
 - Mali-400 3-D Engine
- VPU
 - HD Video Decoding
 - 1920*1080@30fps
 - Support H.264, H.263, VC1, Mpeg1/2/4
 - Divx 3/4/5/6, Xvid, VP6/8, AVS etc
 - HD Video Encoding
 - Support encoding in H.264 format
 - Up to 1920*1080 at 30fps
- DPU
 - LCD Interfaces: CPU, RGB
- Memory
 - DDR2/DDR3: Up to 533MHz
 - 16 bits Data Bus
 - Memory capacity up to 512MB
 - MLC/TLC/SLC/EF-NAND
 - 2 flash chips, ECC 64-bit
 - Support NAND of 5xnm, 4xnm, 3xnm, 2xnm
 - Support NADN of Samsung, Toshiba, Hynix
- Peripherals
 - USB2.0 OTG, USB2.0 HOST
 - (OHCI/EHCI)
 - SD Card V.3.0, eMMC V.4.2
 - SPI, TWI and UART
 - integrated Audio Codec
 - CSI
- R-TP Controller
 - 4-wire resistive TP interface
 - 2 points and gesture detection
- Boot Devices
 - NAND Flash

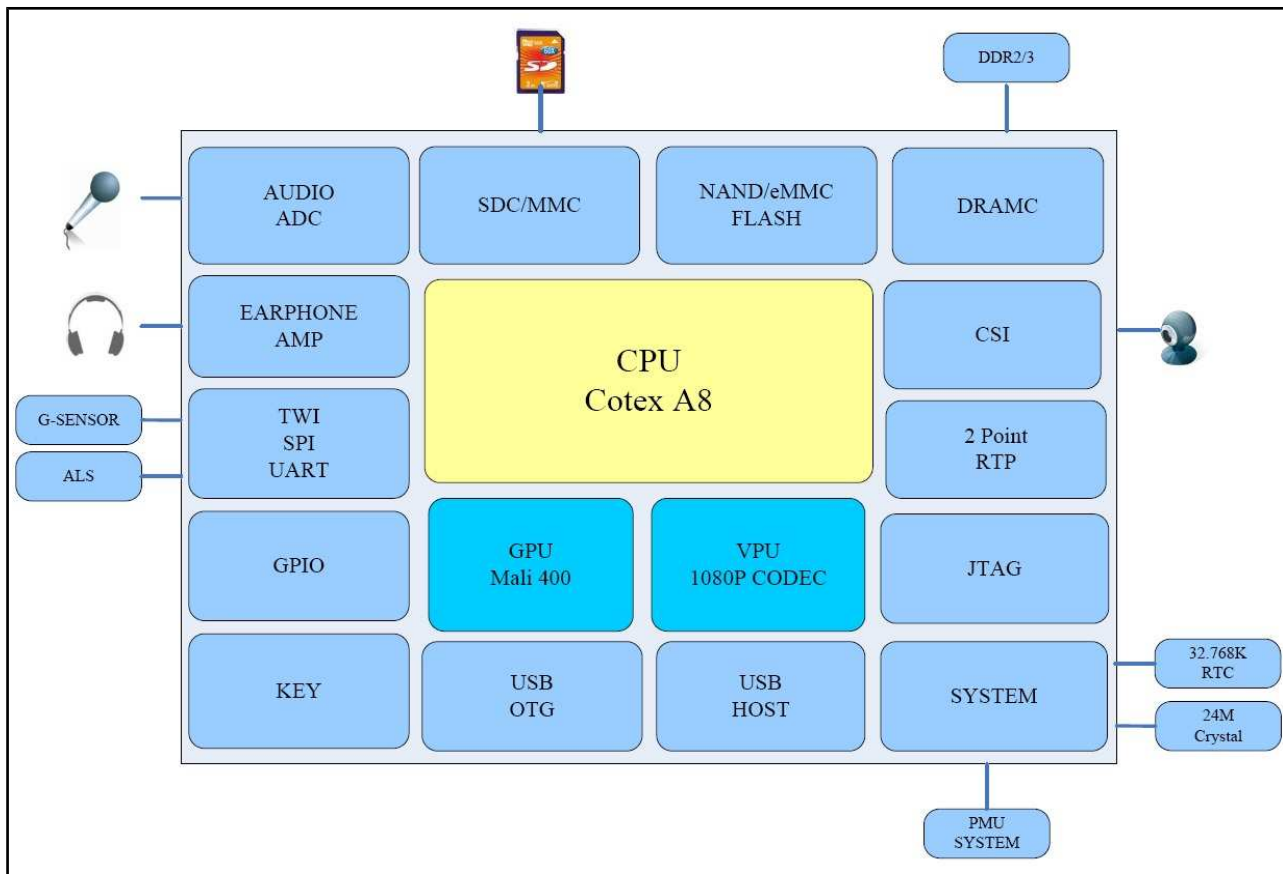
- SPI Nor Flash
- SD Card
- USB
- Powerful Acceleration
 - Graphic (3D, Mali400 MP)
 - VPU (1080P)
 - APU
 - E-Reader
- Ultra-low System Power Consumption
 - 15~20% lower than competitors
 - Smart Backlight: auto adjust backlight
 - acc. to the image display
- Package
 - eLQFP176

More information can be found on Allwinner's web site at the following web-address:

<http://www.allwinnertech.com/product/A13.html>

4.2 Block diagram

The block diagram is taken from Allwinner's datasheet.



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

The reset line is handled by MCP130T-300-I. This is a voltage supervisory device designed to keep a microcontroller in reset until the system voltage has reached the proper level and stabilized. It also operates as protection from brown-out conditions when the supply voltage drops below a safe operating level. The reset goes to processor pin 195. The reset circuit is connected to button RESET, which means pressing RESET would perform a hardware reset on the board.

5.2 Clock

24 MHz quartz crystal Q1 is connected to pins 91 and 92 of the A13 processor.

5.3 Power supply circuit

The 5V power supply is handled by three voltage regulators for the 1.2V, 1.5V and 3.3V power lines.

The board can be powered from the USB_OTG connector. Note that powering from the USB limits the current available for peripheral devices (like mouse, keyboard, LCD display, UEXT modules, etc.).

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 Communication with the A13

The chip has a built-in bootloader but the communication for this type of board is not very useful via the mini USB – the board lacks NAND. However, there is a second option which is the male UART1 connector capable of delivering some information on the COM port of your computer. You can use USB-SERIAL-CABLE-F with the UART1 interface allowing you to connect to an USB port.

Note that we haven't still managed to run Android from the SD card so it might require tweaking the image to be able to do it.

We have had a successful Debian booting from SD card.

6.1.1 USB communication

There is only one USB type A host wired to a USB-controller. This means that an external USB hub is required to ensure you have enough room for all USB devices you might want to use (keyboard, mouse, etc).

6.1.2 UART1 interface

The UART interface might be used for COM communication. You can use our USB-SERIAL-CABLE-F for debugging via the UART1 or UART0. Note that in both cases the connectors and the signals are named at the bottom of the board.

Note that UART0 has only pinholes available, while UART1 has male connectors.

Consider the below table when connecting the USB-SERIAL-CABLE-F according to the wire color code of the cable - GND=BLUE, RX(INPUT)=GREEN, TX(OUTPUT)=RED; note that RX of the cable has to connect to TX of the board and vice versa.

UART0			UART1		
Pin #	Signal Name	Processor Pin #	Pin #	Signal Name	Processor Pin #
1	3.3V	-	1	3.3V	-
2	SDC0_SCK	110	2	UART1_TX	152
3	SDC0_DATA3	112	3	UART1_RX	151
4	GND	-	4	GND	-

Note that UART0 is multiplexed with the SD card.

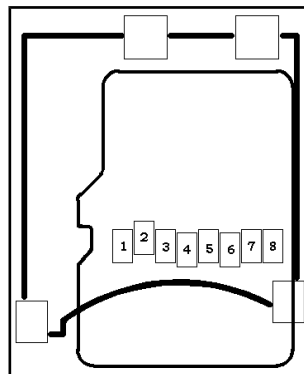
6.2 SD/MMC slot

The microSD card slot is a standard 8pin connector.

The SD card can be used for booting the operating system for A13-OLinuXino-MICRO. It is suggested to have an SD card with a proper Linux/Android image especially since you have ordered a board from the A13 family without built-in memory.

We have tested a number of microSD cards on the OLinuXino boards and all of them worked fine regardless manufacturer or capacity. However, keep in mind that some of the lower quality microSD cards might draw too much current from the slot which might cause power-state problems. If you suspect the microSD card is causing problems please try using another one of better quality for better results.

microSD card connector		
Pin #	Signal Name	Processor Pin #
1	DAT2/RES	113
2	SDC0_DATA3	112
3	SDC0_CMD	111
4	VDD	-
5	SDC0_SCK	110
6	VSS	-
7	SDC0_DATA0	108
8	SDC0_DATA1	107



When removing the card, please make sure that you release it from the connector by pushing and NOT by pulling the card directly (this can damage both the connector and the microSD card).

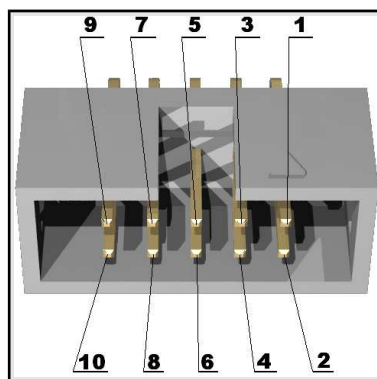
A13-OLinuXino-MICRO-SD

6.3 UEXT module

A13-OLinuXino-MICRO has an UEXT connector and can connect with Olimex's UEXT modules. For more information on UEXT please visit:

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

UEXT connector		
Pin #	Signal Name	Processor Pin #
1	3.3V	-
2	GND	-
3	UART1_TX	152
4	UART1_RX	151
5	TWI2_SCK	161
6	TWI2_SDA	160
7	SPI2_MISO	117
8	SPI2_MOSI	116
9	SPI2_CLK	115
10	SPI2_CS0	114

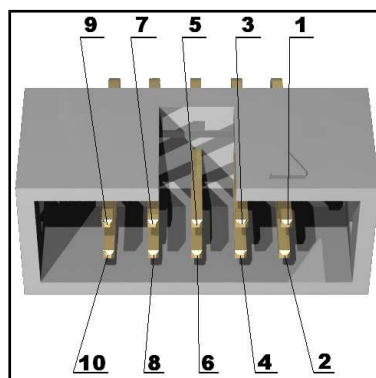


The UEXT pinout is also printed at the bottom of the board under the connector.

6.4 GPIO-1 (General Purpose Input/Output) 10pin connector

The GPIO connector numbers are printed at the bottom of the board for your convenience.

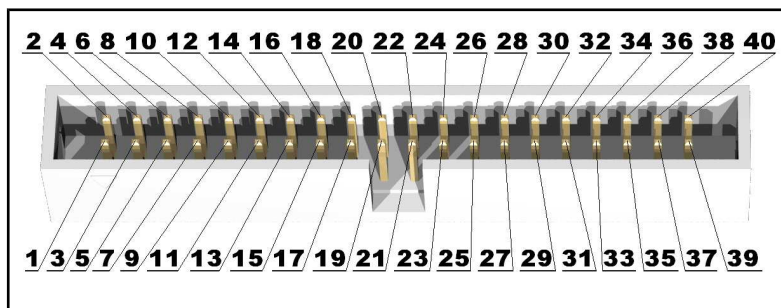
GPIO-1		
Pin #	Signal Name	Processor Pin #
1	5V	-
2	GND	-
3	3.3V	-
4	GND	-
5	RESET_N	159
6	NMI_N	158
7	PIN0	-
8	PIN3	-
9	PIN1	-
10	PIN2	-



PIN0, PIN1, PIN2 and PIN3 are connected to the power regulator module AXP209.

6.5 GPIO-2 (General Purpose Input/Output) 40pin connector

The GPIO pins are led out on a separate 40pin connector. They allow the user to attach additional hardware, check readings or perform hardware debug. The GPIO-2 connector numbers are printed at the bottom of the board for your convenience.

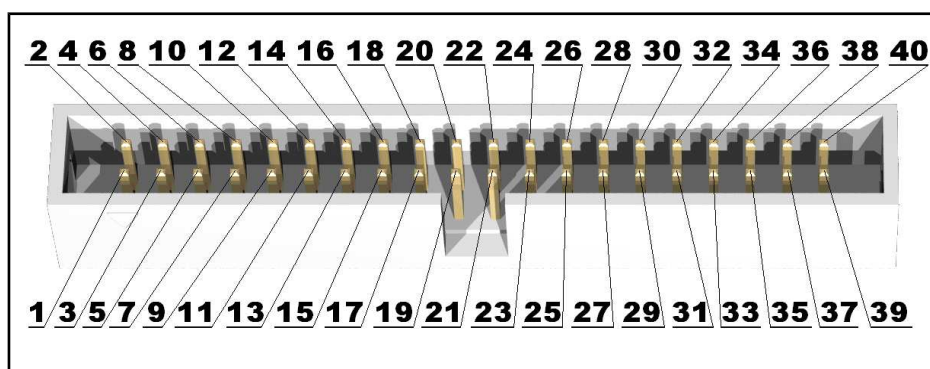


GPIO-2 connector					
GPIO Pin#	Signal Name	Processor pin#	GPIO Pin#	Signal Name	Processor pin#
1	5V	-	2	GND	-
3	3.3V	-	4	GND	-
5	PIN4/TWI0-SCK	101	6	PIN39/USBH_EN	14
7	PIN5/TWI0-SDA	102	8	PIN38/VGA_DIS	13
9	PIN6/PW0	103	10	PIN37/LED1	12
11	PIN7	150	12	PIN36	125
13	PIN8	104	14	PIN35	124
15	PIN9	10	16	PIN34	123
17	PIN10/TWI1-SCK	105	18	PIN33	122
19	PIN11/TWI1-SDA	106	20	PIN32	121
GPIO Pin#	Signal Name	Processor pin#	GPIO Pin#	Signal Name	Processor pin#
21	PIN12/NWE	8	22	PIN31	120
23	PIN13/NALE	7	24	PIN30	119
25	PIN14/NCLE	6	26	PIN29	118
27	PIN15/NCE1	3	28	PIN28/NDQS	162
29	PIN16/NCE0	2	30	PIN27/NDQ7	165
31	PIN17/NRE	1	32	PIN26/NDQ6	166
33	PIN18/NRB0	176	34	PIN25/NDQ5	167

35	PIN19/NRB1	175	36	PIN24/NDQ4	168
37	PIN20/NDQ0	174	38	PIN23/NDQ3	170
39	PIN21/NDQ1	172	40	PIN22/NDQ2	171

6.6 LCD_CON 40pin connector

The LCD_CON pins are led out on a separate 40pin connector for the ease of connecting an LCD. We have tested the ability of the board to interact with such a display. They allow the user to attach additional hardware, check readings or perform hardware debug. The LCD_CON connectors connector numbers are print at the bottom of the board for your convenience.



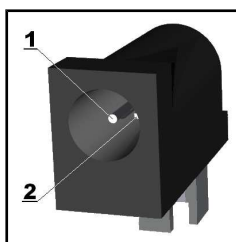
LCD_CON connector					
GPIO Pin#	Signal Name	Processor pin#	GPIO Pin#	Signal Name	Processor pin#
1	5	-	2	GND	-
3	3.3	-	4	GND	-
5	LCD_D18	135	6	LCD_D18	135
7	LCD_D18	135	8	LCD_D19	134
9	LCD_D20	133	10	LCD_D21	132
11	LCD_D22	131	12	LCD_D23	130
13	LCD_D10	141	14	LCD_D10	141
15	LCD_D10	141	16	LCD_D11	140
17	LCD_D12	139	18	LCD_D13	138
19	LCD_D14	137	20	LCD_D15	136
21	LCD_D2	148	22	LCD_D2	148
23	LCD_D2	148	24	LCD_D3	147
25	LCD_D4	146	26	LCD_D5	145

27	LCD_D6	144	28	LCD_D7	143
29	LCD_HSYNC	127	30	LCD_VSYNC	126
31	LCD_CLK	129	32	LCD_DE	128
GPIO Pin#	Name	Processor pin#	GPIO Pin#	Name	Processor pin#
33	PIN7	150	34	PIN8	104
35	PIN9	10	36	PIN6/PWM0	109
37	TPX1	89	38	TPX2	87
39	TPY1	90	40	TPY2	88

6.7 PWR Jack

The power jack used is the typical 2.5mm one used by Olimex in most of our products. You should provide 5 volts @ 1A maximum 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 Headphones and microphone connector

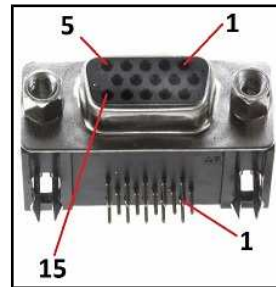
Standard headphone jack and dual pins for microphone are mounted for the audio out/in interfacing.

Microphone/Audio out connector		
Pin#	SIGNAL NAME	Processor Pin#
2	L channel	74
3	R channel	78
5	HPCOM	GND pins

The headphones resistance is 32 Ohms! The mic pads are connected to pins 84 and 85 of the A13 chip. Note that there isn't MIC jack mounted.

6.9 VGA video connector

The female DB15 connector is used for video output on a monitor. At the moment the maximum achieved resolution is 800x600 due to limited maximum frequency and the lack of integrated video controller in the chip.



VGA connector			
GPIO Pin#	Signal Name	GPIO Pin#	Signal Name
1	VGA_R	2	VGA_G
3	VGA_B	4	Not Connected
5	GND	6	GND
7	GND	8	GND
9	GND	10	GND
11	Not Connected	12	Not Connected
13	VGA_HSYNC	14	VGA_VSYNC
15	Not Connected	16	Not Connected

6.10 Jumper description

Please note that all the jumpers on the board are SMD type. If you feel insecure of your soldering/cutting technique it is better not to try to adjust the jumpers.

6.10.1 1.2V_E, 1.5V_E, 3.3V_E

These three jumpers provide test pads during production and debugging. They are You can check the supply voltages. It is not recommended to change their default positions.

The default positions are closed.

6.10.2 HOST_EN

This jumper allows to control the power line on the USB_HOST. If it is open it is disconnected from the USB_HOST connector and the devices are always powered. If it is closed it is connected to the processor and can be controlled when to power via software means.

Default positions is open.

6.11 Additional hardware components

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

UBOOT button – used to enter bootloader mode

Reset button – used to reset the board

256GB (128Mbit x 16) DDR3 SDRAM – the exact memory used in the first revisions of the board is HYNIX H5TQ2G63BFR

LED1 + PWR_LED – GPIO LED + power-on LED

CHAPTER 7: SCHEMATICS

7. Introduction to the chapter

In this chapter are located the schematics describing logically and physically A13-OLinuXino-MICRO.

7.1 Eagle schematic

OLinuXino schematic is visible only for reference here. You can also find it on the OLinuXino's GitHub repository: <https://github.com/OLIMEX/OLINUXINO>. They are located in HARDWARE section.

You are allowed to view and edit the schematics as long you keep them free and you mention at least the source address (e.g. <https://www.olimex.com>), as according to Creative Commons Attribution-Share.

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

