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Understanding Embedded - Microcontroller, Microprocessor, FPGA Modules

Embedded - Microcontroller, Microprocessor, and FPGA Modules are fundamental components in modern electronic systems, offering a wide range of functionalities and capabilities. Microcontrollers are compact integrated circuits designed to execute specific control tasks within an embedded system. They typically include a processor, memory, and input/output peripherals on a single chip. Microprocessors, on the other hand, are more powerful processing units used in complex computing tasks, often requiring external memory and peripherals. FPGAs (Field Programmable Gate Arrays) are highly flexible devices that can be configured by the user to perform specific logic functions, making them invaluable in applications requiring customization and adaptability.

Applications of Embedded - Microcontroller,

Details	
Product Status	Discontinued at Digi-Key
Module/Board Type	MCU Core
Core Processor	Allwinner ARM® Cortex®-A8
Co-Processor	-
Speed	1GHz
Flash Size	-
RAM Size	512MB
Connector Type	-
Size / Dimension	-
Operating Temperature	-
Purchase URL	https://www.e-xfl.com/product-detail/olimex/a13-som-512

CHAPTER 1: OVERVIEW

1. Introduction to the chapter

Thank you for choosing this single board computer from Olimex! This document provides a user's guide for the A13-SOM boards. It covers both the -256 and the -512 version board. In the text below 'A13-SOM' is used to address both "A13-SOM-256" and "A13-SOM-512"; if a specific feature is available to only one of the boards then this is specifically mentioned and the board is addressed with the RAM-indicating suffix.

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 A13-SOM development board enables code development of applications running on the A13 microcontroller, manufactured by Allwinner Technology from China.

The A13-SOM board is typically used together with A13-SOM-WIFI or A13-SOM-WIFI-4GB which provides the following expansions over the original design:

1) an USB-OTG connector for easier powering or adding USB modules to the board (via a splitter or adapter)
2) a built-in WIFI module (Realtek 8188CUS)
3) an LCD display connector with 0.1" step
4) 4GB NAND memory (only in A13-SOM-WIFI-4GB)

All of the features listed above are also supported in the software releases suitable for the board.

The hardware design of A13-SOM development board is considered intellectual property to Olimex. The hardware design files are considered copyright material and would not be distributed.

The expansion boards available for A13-SOM are an open-source, open-hardware projects and all documentation is available to the customer.

The software support for both boards is open-source and released under GPL license.

1.1 Introduction to SOM (System-On-a-Module)

OLIMEX System-on-Module (SOM) boards are powerful Linux-capable boards. They follow a low-cost modular design which allows rapid product development. Each of these boards has two parts – a main part which nests the processor, the memory and the power control unit and the peripheral part which contains the USB ports, the video output and most of the connectors. SOM designs are targeted at customers who want to apply custom modifications and own solutions based on a specific processor without having to deal with multi layer PCBs with controlled impedance and BGA assembly. This makes it possible to create simple boards (that might be manufactured by your local board manufacturer) containing only the peripherals you need with the dimensions and shape suitable for your specific solution.

1.3 Features of A13-SOM boards

The A13-SOM board has the following set of features:

- Allwinner A13 Cortex-A8 processor typically running at 1Ghz
- **256MB or 512MB DDR3 memory, depending on the board version – please note that the 256MB version is not suitable for a smooth Android experience**
- Power management DCDC
- MicroSD card
- UART console connector
- 4 connectors 0.05" step
- Status LEDs
- RESET, UBOOT/HOME buttons
- Dimensions: (2400×2100)mil ~ (61×53)mm

1.4 Board variants

There are two major board variants named: A13-SOM-256 and A13-SOM-512. The 256 version has 256MB of DDR3 RAM memory compared to the 512 version that has double the amount.

It is important to notice that the 256MB of DDR3 RAM are insufficient to run Android OS properly. If you are interested in Android development for Allwinner A13 I recommend you to get the 512MB version of A13-SOM.

A similar board is A13-OLinuXino – it is meant for fully evaluating the capabilities of A13 processor. if you are going to implement A13-SOM into custom design it would be a good idea to first check on the A13-OLinuXino – it would be easier to evaluate the capabilites of the A13 processor, due to the

The other Olimex board with close characteristics is A20-SOM board. It is a bit bigger and a bit more expensive. However, has a generation newer dual-core processor that is better for heavy computations (for instance, high resolution video decoding and encoding). The A20-SOM board also has a bigger extension shield with almost all of the peripherals supported by the A20 processor. This extension is named 'A20-SOM-EVB'.

1.5 Board version used in the manual

A13-SOM-256 revision D board and A13-SOM-512 revision D boards were used while writing this document. It is possible that part of the information is outdated.

CHAPTER 2: SETTING UP THE A13-SOM BOARD

2. Introduction to the chapter

This section helps you set up the SOM 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 and electrical polarity warning

A13-SOM boards are 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.

If you connect other electrical devices to the SOM board make sure that they have equal electrical polarity. This is also true for a serial cable connected between a PC and the board's DEBUG port. In rare cases different polarity might cause hardware damage to the board.

2.2 Requirements

In order to set up the A13-SOM board optimally one or more additional items may be needed. They might be generally placed in two 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;

Note that if A13-SOM-WIFI or A13-SOM-WIFI-4GB is mounted on A13-SOM – the requirements would be different! The requirements below are for a stand-alone use of A13-SOM. Refer to A13-SOM-WIFI's user's manual for adjusted requirements.

Required items:
- 5V-external power supply with proper connectors – A13-SOM has no power jack, only powering pins (5VEXT, GND)
- Output device – USB-SERIAL-CABLE-F + personal computer (for Linux and/or Android debugging) – A13-SOM lacks other options for debugging – you would need a serial cable with level-shifter to interface the board
- SD card with compatible image – if you have the board version with NO additional NAND memory you will need it to use one of the images available. If you decide to use Debian you would also need a card. Official Android and Debian images are available at the wiki article for the board.

Sometimes when starting Android it is possible the board to enter battery save mode even before booting fully. Especially, if you have turned off the board without quick boot mode enabled. In this case you should press the PWR button for at least 5 seconds which would allow the board to start.

2.3.2 Mounted powering

Typically, A13-SOM gets evaluated when mounted connected with A13-SOM-WIFI. In this case the former is powered via the latter. The power line, altogether with a number of other important processor lines, is transferred via the 10-pin and 40-pin headers. A13-SOM receives power from A13-SOM-WIFI, but what are the requirements to power A13-SOM-WIFI?

There are two main scenarios for the powering A13-SOM-WIFI (and respectively A13-SOM):

1) a miniUSB cable connected to either a personal computer or a 5V power source; A13-SOM-WIFI has miniUSB connector – note that USB ports of personal computers usually provide up to 0.5A of current – this might be insufficient in certain cases. For example, if you have a lot of peripherals or a display powered by the board.

2) +5V directly provided to GPIO row of pinholes (the pinholes are called +5V and GND – near the PWR_LED and the USB_OTG); these pins can be used to connect a power jack

Some typical consumptions are listed below:

- A13-SOM-512 + A13-SOM-WIFI-4GB running Debian – consumption: 0.45A @ 5V
- A13-SOM-512 + A13-SOM-WIFI-4GB + A13-LCD7-TS running Debian – consumption: 0.75A @ 5V
- A13-SOM-512 + A13-SOM-WIFI-4GB + A13-LCD7-TS running Android – consumption: 0.40A @ 5V

Do not provide AC voltage to the A13-SOM-WIFI board! Do not provide more than 5V of voltage to the A13-SOM-WIFI board!

The default username/password combination for the default Linux image on the SD card (if purchased) is: root/olimex.

Note that it is normal that when the board is powered some integrated circuits might appear hotter than others. This is perfectly normal for some electronic components (for instance – the voltage regulators and the main processor).

2.4 Button functions

The two buttons usually are supported under both Android and Debian:

RESET – used to perform software turn off, software turn on; used to turn on board when powered by battery – has to be held down for at least 5 seconds to perform each action
UBOOT/HOME – used to boot up the board, can be used for navigation in Android

Note that: the board lacks recovery button! This is not a problem if you are using Debian Linux. However, it would make it impossible to wake the board in Android. You would need to disable

have provided a shell script that can be executed in order to set preferred video output and resolution.

For Android that you boot from the NAND memory you would need an image suitable for the specific resolution. Download locations to such images might be found at the wiki article for the A13-SOM board here: https://www.olimex.com/wiki/A13-SOM.

For Linux Debian you would need to execute a shell script to be able to change the resolution. It is very good idea to use a serial cable for connection to the board from a personal computer since in this case you are dependent on a video resolution (a cable like USB-SERIAL-CABLE-F). When the board boots type:

./change_display*

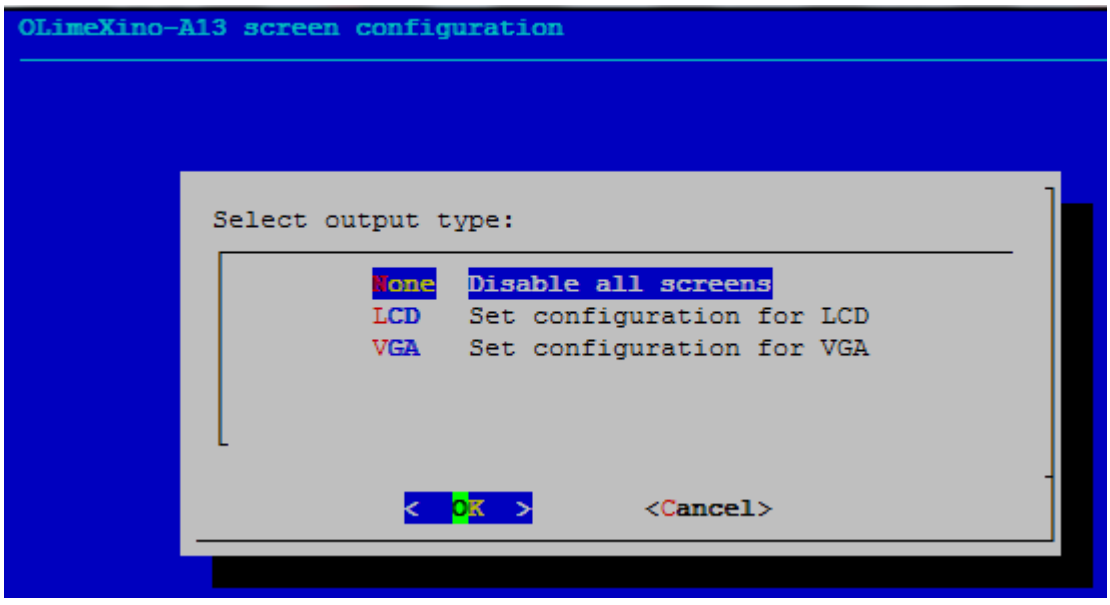
or

./change_display_a13.sh

It looks like this:

```
root@a13-OLinuXino-Micro-SOM:~# ./change_display_a13.sh
fexc-bin: /tmp/screen/script.bin: version: 0.1.2
fexc-bin: /tmp/screen/script.bin: size: 29588 (58 sections)
```

Then the main menu of the video configuration script shows up:



Choose the resolution and the interface (LCD or VGA). Note that VGA output is hard to implement and requires both additional hardware and good soldering experience.

The supported resolutions are listed on the next page.

2.7.1 Android calibration

Calibrating a display under Android is pretty straightforward from the Android application.

Important: initially the boards are calibrated for a specific display and resolution. If you re-write the image (no matter whether the SD card or the NAND memory) you might need to use a mouse to calibrate the display initially. It might be impossible to calibrate it only by using the touch component over the display.

2.7.2 Debian calibration

The command that allows calibrating in Debian Linux is:

ts_calibrate

The default Debian video output configuration is set to 7 inch LCD display (800×480). If you want to change to other video output resolution refer to chapter 2.6 Changing the default image resolution.

If the problem is under Debian Linux make sure you are properly logged in the LXDE interface! Else applying calibration would not happen for the current user – if you are calibrating from the X graphical interface make sure that you are logged as user “olimex” (if calibrating without the X, the user is “root”).

#su olimex

enter the password: “olimex”, then calibrate the touch screen and reboot the board

#sudo reboot

2.8 Software support

We maintain Linux and Android images for SD card which might be downloaded for free and modified as the user wishes. The latest images and updates are featured at the wiki article of the device: https://www.olimex.com/wiki/A13-SOM.

We usually try to provide details on how to build the Linux and the Android images at our wordpress page: http://olimex.wordpress.com/.

Another useful place is the Olimex forums where a lot of people share their experience and advice: https://www.olimex.com/forum/.

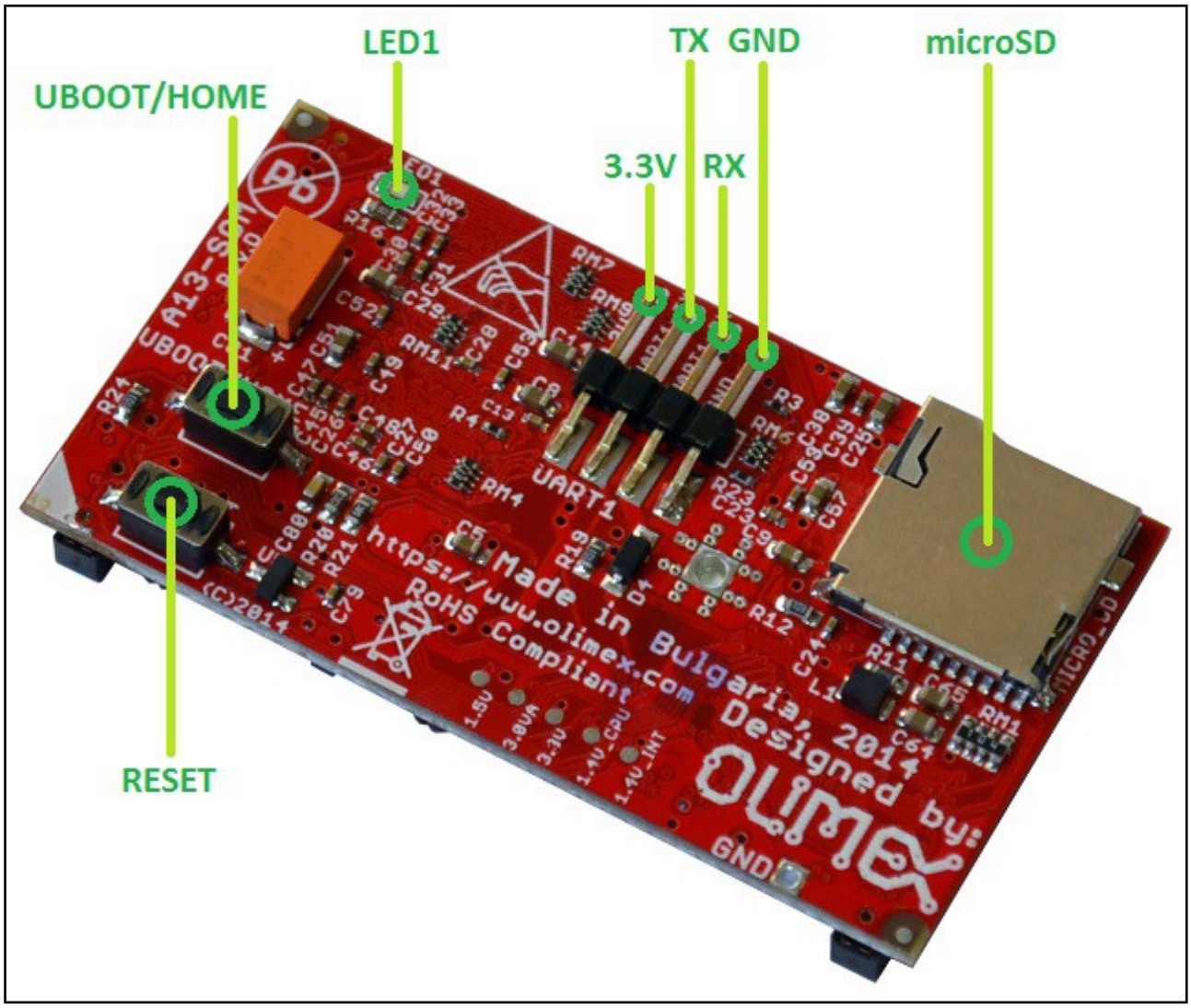
The official images are a constant work-in-progress – newer releases are packed with better hardware support, newer kernels and extra features.

You are more than welcome to send or share your suggestions and ideas at our e-mail, the public forums or irc channel. We would attempt to help in almost every case. We listen to the feedback and if the majority of users suggest a software change or update we try to implement such. Customer feedback is very important for the overall state of the software support. However, do not expect full

Linux or Android software support.

We can share our experience. We can give you full details for things we have tried. We can point you to a resource or a guide. We can give you general directions to solving a specific problem or places to look for more information. However, we won’t install a piece of software for you or write custom program for you. We won't provide a specific software solution to a specific software problem.

3.2 Layout (bottom view)



CHAPTER 4: THE ALLWINNER A13 MICROCONTROLLER

4. Introduction to the chapter

In this chapter is located the information about the heart of A13-SOM – its microcontroller. The information is a modified version of the datasheet provided by its manufacturers.

4.1 The processor

The full list of features might be found below:

- 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

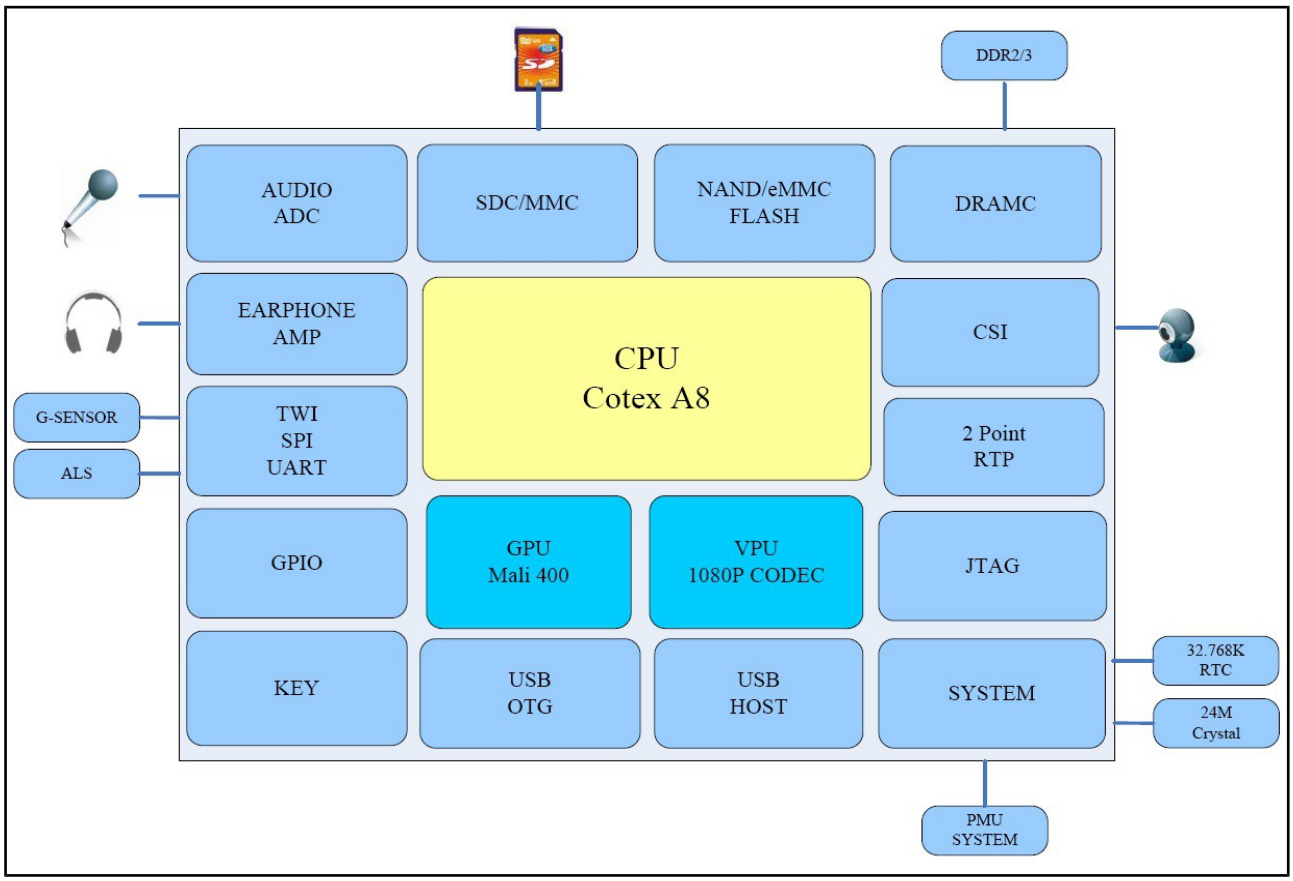
- SD Card
- USB

- Powerful Acceleration
  - Graphic (3D, Mali400 MP)
  - VPU (1080P）
  - APU
  - E-Reader
- Ultra-low System Power Consumption
  - 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 web-site.



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 also briefly discussed.

5.1 Reset

The board can be reset by the RST button. The reset circuit includes Microchip's MCP130T-300I, designed to keep a microcontroller in reset until the system voltage has reached the proper level and stabilized.

The board should be turned off either by the standard OS menu or “poweroff” command or any other software shutdown procedure. After the choice is confirmed it is safe to disconnect the power supply unit from the board.

5.2 Clocks

24 MHz quartz crystal Q1 is found at pins 91 (X24MOUT) and 92 (X24MIN) of the A13 processor.

5.3 Power supply circuit

The current consumption for A13-SOM when used separately is around 0.1A when connected to a 3.3V voltage source (provided either at GPIO-1's pin 1 or UART1 3.3V pin).

There are several GND pin and pinhole locations. You can use any of the board's GND for powering purposes.

The typical consumption of the 512 for the board when combined with A13-SOM-WIFI-4GB might be found below:

Setup	Operating system	Typical current consumption, in Amperes, at 5V of voltage
A13-SOM-512 + A13-SOM-WIFI-4GB	Debian	0.45A
A13-SOM-512 + A13-SOM-WIFI-4GB + A13-LCD7-TS	Debian	0.75A
A13-SOM-512 + A13-SOM-WIFI-4GB + A13-LCD7-TS	Android	0.40A

The current consumed usually reaches peaks during start-up when different modules are initialized. Make sure the supply you provide is capable of powering the board. Note that if there are additional modules powered by the board, the total power supply requirement would grow. For example, bigger LCD displays powered via the A13-SOM almost double the current consumption.

For more info on how to power the board refer to chapter “2.3 Powering the board”.

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 A13-SOM

There is only one way to communicate with A13-SOM without hardware modifications – it is via a serial cable. If A13-SOM-WIFI is also used, you might also interface the setup via a display or via SSH.

The direct communication method is via the serial interface. Through male UART1 connector capable of delivering some information on the COM port of your computer – and then use your favorite terminal program (puTTy, teraterm, etc) to receive the data/send commands. You can use USB-SERIAL-CABLE-F with the UART1 interface allowing you to connect to a personal computer with a free USB port.

Note that the levels at board's UART1 are in CMOS levels (3.3V) and you would need a MAX232 convertor to bring them to TTL ones! This includes the RX and TX line.

It is highly recommended to have an USB-SERIAL-CABLE-F (or similar product) even if you intend to use the board with a monitor or display. Serial cables usually have built-in MAX232 convertor. In case you set wrong display settings you would be able to recover the settings via the UART1 connection.

For more information please refer to chapter “2.5 Interacting with the board”.

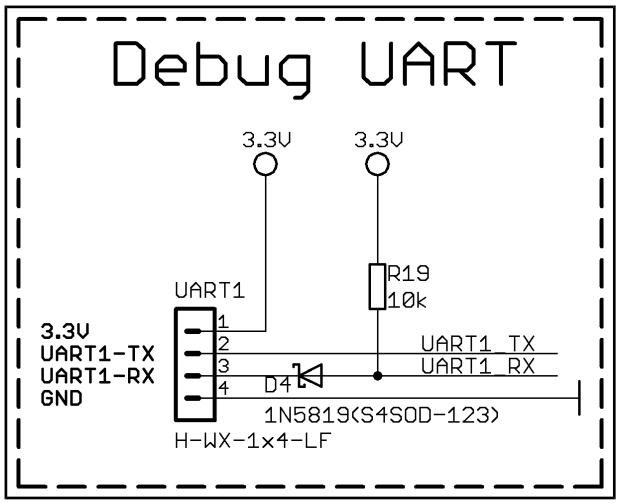
6.1.1 UART1 interface

The UART1 interface might be used for serial communication between the board and a personal computer by default. In case of video output problem a cable might provide needed feedback and greatly reduce the efforts needed to repair the board or to adjust the software setting.

Note that by default only UART1 is defined as a port suitable for serial debug. You can use our USB-SERIAL-CABLE-F for debugging.

Even when A13-SOM is mounted on A13-SOM-WIFI the default debug port remains UART1 (despite that it gets additional pins on the big board also for easier access).

Consider table below when connecting the USB-SERIAL-CABLE-F according to the wire color code. The RX line of the cable (GREEN wire) should go to TX line of the target board; the TX line of the cable (RED wire) should go to the RX line of the target board. The BLUE wire should go to the target's GND line. Make sure to leave free the first pin (named “3.3”) when connecting the serial cable.



The table of UART1 signals might be found below:

UART1		
Pin #	Signal name	Processor pin
1	3.3	VCC
2	UART1-TX	A7
3	UART1-RX	B7
4	GND	GND

6.2 MicroSD card connector

The micro SD card slot is primarily used for booting the operating system.

The board works with micro SDHC cards up to 32GB of storage.

As a general precaution be careful with the SD cards you purchase. There is a big percentage of fake cards due to the low effort required to counterfeit popular brands and the big demand for SD cards worldwide. When in doubt – try the same operation with another card from another brand.

Olimex sells microSD cards prepared with Linux or Android images, that have been tested – please refer to chapter “2.2 Requirements”. Currently these are with either 4GB and 8GB of storage (depending on the purchase date). Of course, if you already have a large enough microSD card you can download the official Linux image from the wiki pages: https://www.olimex.com/wiki/A13-SOM.

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).

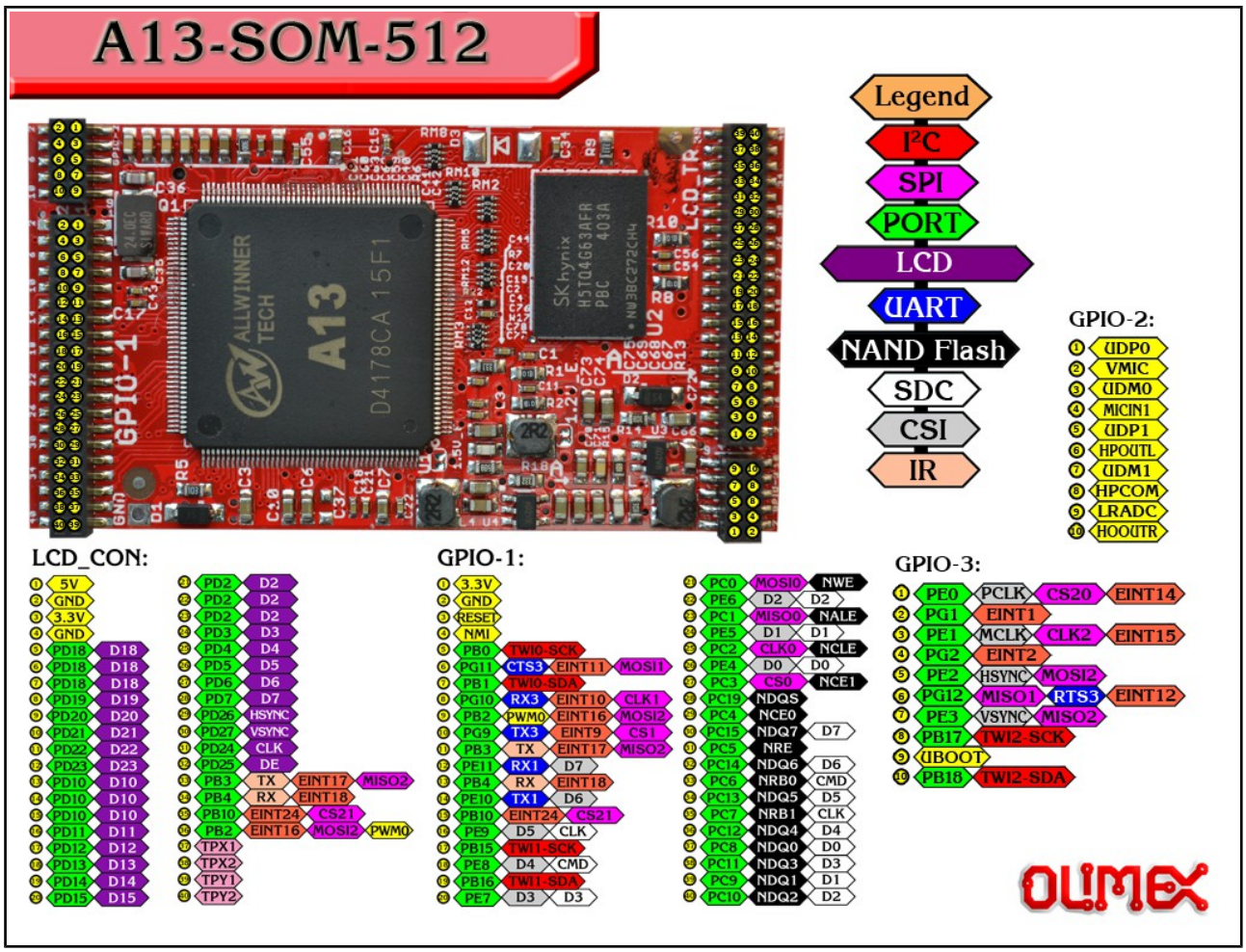
The recommended way of powering the board is via A13-SOM-WIFI.

More information about the powering can be found in chapter “5.3 Power supply circuit” of this manual.

6.4 GPIO connectors

There are 3 female GPIO connectors all located on the top side of A13-SOM. They ease the access to processors pins. These connectors also provide a way to mount the board to a board with peripherals like A13-SOM-WIFI. The first of the GPIO connectors is a 40-pin one and the other two are 10-pin ones.

Below you would find a general overview of the board's GPIO and LCD pins. They might be also found in the tables further down in the chapter. To understand better what each processor pin does it might be a good idea to refer to the datasheet of the A13 processor. The schematic of the board of peripherals A13-SOM-WIFI might also help you identify the main function of the pins.



To keep the form factor as small as possible the GPIO connectors have 0.05" step.

IMPORTANT: the connectors are very fragile – if you attempt to disconnect the board by pulling only one side out it might break! Furthermore – you might bend the board's pins! Use pliers or other suitable object to disconnect the connectors carefully!

Note that signals PIN6/PWM0, PIN7, PIN8, PIN9 (respectively pins 36, 33, 34, 35) are also available at the LCD_TR connector. Avoid multiplexing.

6.6 Jumper description

The board has a couple of hardware SMT jumpers which are used during the testing of the board.

It is not recommended to change the position of any jumpers located on A13-SOM.

Board jumpers			
Jumper name	**Type**	**Default position**	**Function**
1.5V_E	SMT	CLOSED	If open disables 1.5V to the A13
1.2V_E	SMT	CLOSED	If open disables 1.2V to the A13

6.7 Additional hardware components

The components below are mounted on the A13-SOM but are not discussed above. They are listed here for completeness:

Reset button – used to reset the board
Power button – used to reset the board

A13-SOM-256 has 256MB RAM = 1×[2Gb(128M x 16)] DDR3 SDRAM – the exact memory used in the board revision mentioned is Hynix 5TQ2G63BFR

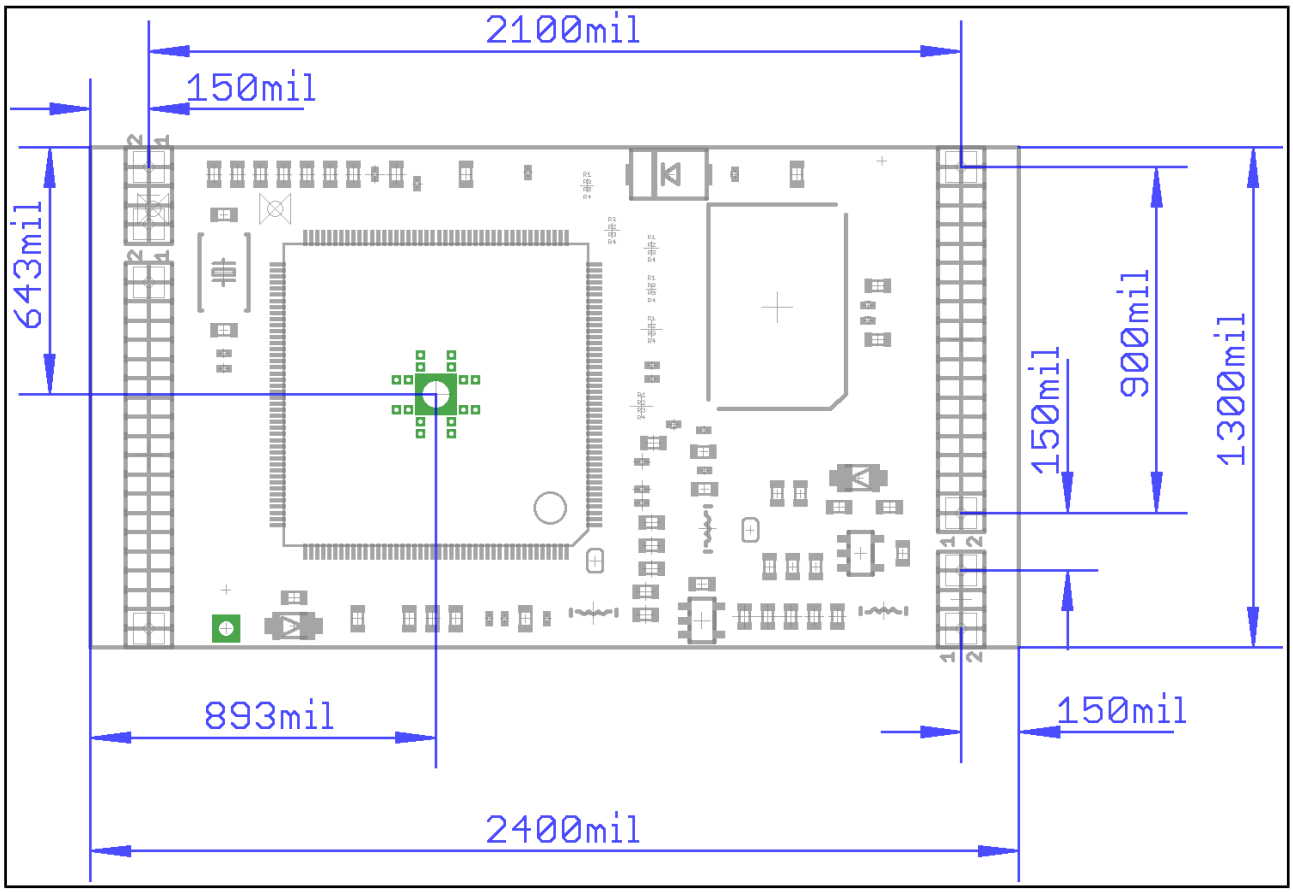
A13-SOM-512 has 512MB RAM = 1×[4Gb(256M x 16b)] DDR3 SDRAM – the exact memory used currently in the board is SAMSUNG K4B4G1646D-BCK0

The DDR3 memory part name in the schematic might be outdated. We have used a number of different but fully compatible DDR3 memories due to supply unavailability. It is always recommended to check the exact memory name printed on the component itself.

LED1 – green – user-programmable LED, turns after a successful boot.

7.2 Physical dimensions

Note that all dimensions are in mils.



8.4 Frequently asked questions

Q: I powered my board, it showed a logo and then nothing happened. What might be the problem?

A: This might be due to a number of reasons but it is recommended to try the following:

1. Download latest official image from our wiki (preferably Debian for SD card), and upload it to an SD card again. There are instructions how to do it in the other questions below. Try if the board works now.

2. Check if your power supply provides enough current, try with different/better power supply.

3. If using A13-SOM-WIFI, please check the USB hub you are using, plug the USB cable directly to the back of your personal computer, check the USB cable.

4. The board might enter sleep mode very fast (especially if the Android was turned off without the “Quick Boot” mode being ticked on). Try pressing or holding down the PWR button for a couple of seconds to wake it up.

Q: How do I write the Linux image to a micro SD card to use with my A13 board?

A: First visit the wiki article for the board and download the archive with the image. Then write the Linux image to a microSD card.

Under Windows we use Win32 Disk Imager: http://sourceforge.net/projects/win32diskimager/

Download Win32 Disk Imager software
Insert card
Start program
Select file
Click "write"

To write a Linux image to an SD card under Linux:

For instance you have an image with the file name of "debian_2g.img". It would be downloaded to the SD card connected to a Linux machine using one of the following commands:

```
# dd bs=4M oflag=sync if=debian_2g.img of=/dev/sdX
```
or

```
# cp debian_2g.img /dev/sdX
```

where X is the uSD card.

Q: How to generate boot-able SD-card Debian Linux image for A13-SOM-256?

The building instructions might be found at the following link: google drive

Official Wordpress post on Debian image release: Wordpress post

Q: How to detect and enable the Ethernet controller (if it is disabled by default)?

A: You can enable it by following these two steps:

1. To check under what name the LAN is associated write "ifconfig –a"
2. If, for example, it is under eth0 name, then write: "dhclient eth0"

This should enable the Ethernet and then SSH would also be available.

You can also enable auto detection of Ethernet on power-up by removing the comment #auto eth0 in /etc/network/interfaces in the Linux image.

How to download Android image to the NAND memory of my A13-SOM board?

The only A13-SOM setup suitable of booting Android from the NAND memory is A13-SOM-512 with A13-SOM-WIFI shield.

To repair the image on the NAND re-upload it following these steps:

1. Install and run LiveSuit (can be found here: google drive). Another location for LiveSuit at the Linux sunxi wiki: http://linux-sunxi.org/LiveSuit
2. Download and extract the latest official image from the Android section of the wiki: A13-SOM-256 article. Make sure that the download link you visit clearly indicates that the image is suitable for the NAND memory since there are images suitable for microSD card also. The images suitable for the microSD memory and those suitable for microSD card are different. However, the upload method is almost identical – using LiveSuit.
3. Go to firmware tab of the program and point to the already downloaded and extracted Android image.
4. Disconnect the power supply and USB cable from the A13 board.
5. Press and hold UBOOT/HOME button, apply power supply (the requirement varies), release UBOOT/HOME button.
6. Connect USB cable to the mini USB connector of A13-SOM-WIFI
7. You will be asked for drivers for the bootloader. Navigate to the folder where you extracted the LiveSuit and install the drivers from the respective executable (or manually point the installer to the drivers folder in the LiveSuit installation path).
8. LiveSuit will detect the board and would ask whether you wish to also of writing the image. Choose method of writing the image and confirm your wish to write the image.
9. Wait till upgrade succeeds.

Note that it is not recommended to have your mini USB connected to an external USB hub. This might cause delays and might distort the signal levels. Always test with the USB connected straight to the USB ports of your computer.

8.5 Product support

For product support, hardware information and error reports mail to: support@olimex.com. All document or hardware feedback is welcome. 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.

All goods are checked before they are sent out. In the unlikely event that goods are faulty, they must be returned, to OLIMEX at the address listed on your order invoice.
OLIMEX will not accept goods that have clearly been used more than the amount needed to evaluate their functionality.

If the goods are found to be in working condition, and the lack of functionality is a result of lack of knowledge on the customers part, no refund will be made, but the goods will be returned to the user at their expense.

All returns must be authorized by an RMA Number. Email support@olimex.com for authorization number before shipping back any merchandise. Please include your name, phone number and order number in your email request.

Returns for any unaffected development board, programmer, tools, and cables permitted within 7 days from the date of receipt of merchandise. After such time, all sales are considered final.

Returns of incorrect ordered items are allowed subject to a 10% restocking fee. What is unaffected? If you hooked it to power, you affected it. To be clear, this includes items that have been soldered to, or have had their firmware changed. Because of the nature of the products we deal with (prototyping electronic tools) we cannot allow returns of items that have been programmed, powered up, or otherwise changed post shipment from our warehouse.

All returned merchandise must be in its original mint and clean condition. Returns on damaged, scratched, programmed, burnt, or otherwise 'played with' merchandise will not be accepted.

All returns must include all the factory accessories which come with the item. This includes any In-Circuit-Serial-Programming cables, anti-static packing, boxes, etc.

With your return, enclose your PO#. Also include a brief letter of explanation of why the merchandise is being returned and state your request for either a refund or an exchange. Include the authorization number on this letter, and on the outside of the shipping box.

Please note: It is your responsibility to ensure that returned goods reach us. Please use a reliable form of shipping. If we do not receive your package we will not be held liable.

Shipping and handling charges are not refundable. We are not responsible for any shipping charges of merchandise being returned to us or returning working items to you.

The full text might be found at https://www.olimex.com/wiki/GTC#Warranty for future reference.