

NOVASOMM8



Hardware User Manual

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1 : Welcome to the NOVASOM M8 world

Thank you for choosing this NOVASOM Industries product.

Please carefully read this user guide before using the device for the first time to ensure safe and proper use.

In particular note that :

- Contents and illustrations may differ from your device, depending on the software version, OS version or product improvements that NOVASOM Industries judges important, and are subject to change without prior notice. Always stay updated visiting www.novasomindustries.com .
- Descriptions are based on the device default settings.
- Modifying the device, the device's operating system or installing software from unofficial sources may damage the device itself and lead to data corruption or data loss, or worst, hardware damage. Such actions will violate your NOVASOM Industries license agreement and void your warranty.
- Always use genuine NOVASOM Industries accessories. The supplied items are designed only for this device and may not be compatible with other devices. To have further information on this specific item visit www.novasomindustries.com .
- Default applications on the device are subject to updates, and support for these applications may be withdrawn without prior notice. If you have any questions about an application provided with the device, please contact NOVASOM Industries at www.novasomindustries.com .
- Software, audio, wallpaper, images, and other media supplied with your device or found in the appropriate SDK are licensed for limited use. If you extract and use these materials for commercial or other purposes, you may be infringing copyright laws. As a user, you are fully responsible for the illegal use of media.

The NOVASOM M8 family is a product line from NOVASOM Industries, targeted toward the low price market (vending, domotics, IoT, etc.) and designed to compete with low cost boards while maintaining NOVASOM Industries high quality level.

NOVASOM M8 is a very small NOVASOM board, approximately credit card size, but with all the necessary to guarantee an immediate bootstrap, driving a display, connecting via Ethernet and USB. It's equipped with one 2.54 mm. dual row strip PI compatible for external expansions.

1 product with different configurations is available:

- NOVASOM M8C: with Qualcomm® APQ8016 quad A53 processor @1.2GHz, 1GB RAM DDR3L

This will vary with time, more information about product status and availability can be found visiting www.novasomindustries.com .

2 : Features

From the integrator point of view the board is a full-fledged SBC, with video and communications capabilities and requires a single supply from a wall cube or a generic external power supply.

The main characteristics of the NOVA**som** M8 are:

On Board Peripherals:

- 1GBytes 32 bit wide LPDDR
- 8GBytes eMMC
- 1 bootable μ SD slot up to 128GBytes
- 1 Ethernet port @ 10/100/1000 Mbit/sec.
- 1 HDMI video output port
- 1 MIPI DSI video connector (can be used in place of HDMI output)
- 1 IPI CSI camera connector
- 1 Integrated RTC with optional external battery connector
- Audio codec on dedicated expansion connector J7
- 1 USB 2.0 Host connector + 1 USB 2.0 OTG connector
- 2 USB 2.0 expansion connector
- Console RS232 serial port and auxiliary RS232 serial port on dedicated connectors
- 1 Remote IR input with connector
- 1 optical SPDIF out expansion connector
- 1 Power led and 1 User Driven led
- Standard 2.5mm Power Supply Jack for 6.5Vcc to 12Vcc input, central positive
- WiFi / BlueTooth /GPS modules with integrated patch antenna (UFL antenna connectors available as option)

On Expansion Connectors (J19):

- 1 I2C @ 3.3V
- 1 SPI @ 50 MHz maximum
- 8 GPIO @ 3.3V
- 1 Full UART @ 3.3V (TX ; RX ; RTS ; CTS)
- 1 PCM AUDIO @ 3.3V

- 1 x RS232
- 1 x μ SD/eMMC plus 3 GPIO
- 1 x TX/RX only UART

The connectors J19 is normally not equipped with the pin strip.

The user has so the choice to use a male or female contact type, and to solder the strips on top or bottom of the NOVA**som** M8, use partially populated connectors or a mix of them.

3 : Description

The NOVASOM M8 family is equipped with Qualcomm APQ8016 quad A53 processor , 1GByte DDR3L + 8GBytes eMMC and WiFi/BT, 10/100/1000 Mbps Ethernet with magnetic connector on board and PI compatible expansion connector.

Visit www.novasomindustries.com for additional information.

4 : Connectors and LEDs description and Configuration

4.1 Connectors list and their function

In Figure 1 you can see the NOVASOM M8 board components top placement, while in Figure 2 you can see the NOVASOM M8 board components bottom placement.

In Figure 3 and 4 are marked just the connectors.

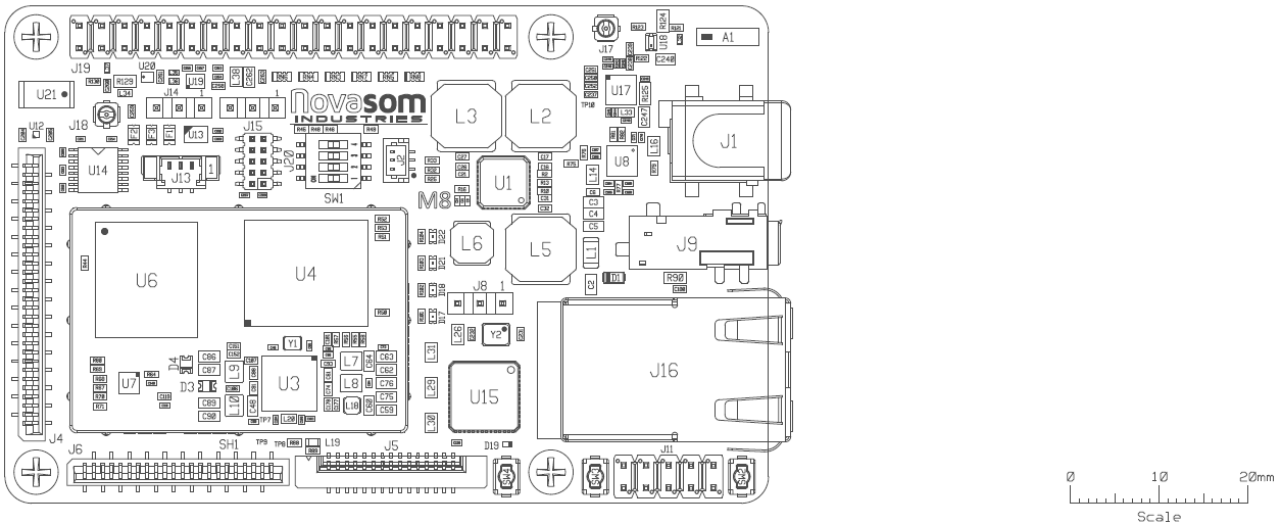


Figure 1 : NOVASOM M8 top general view

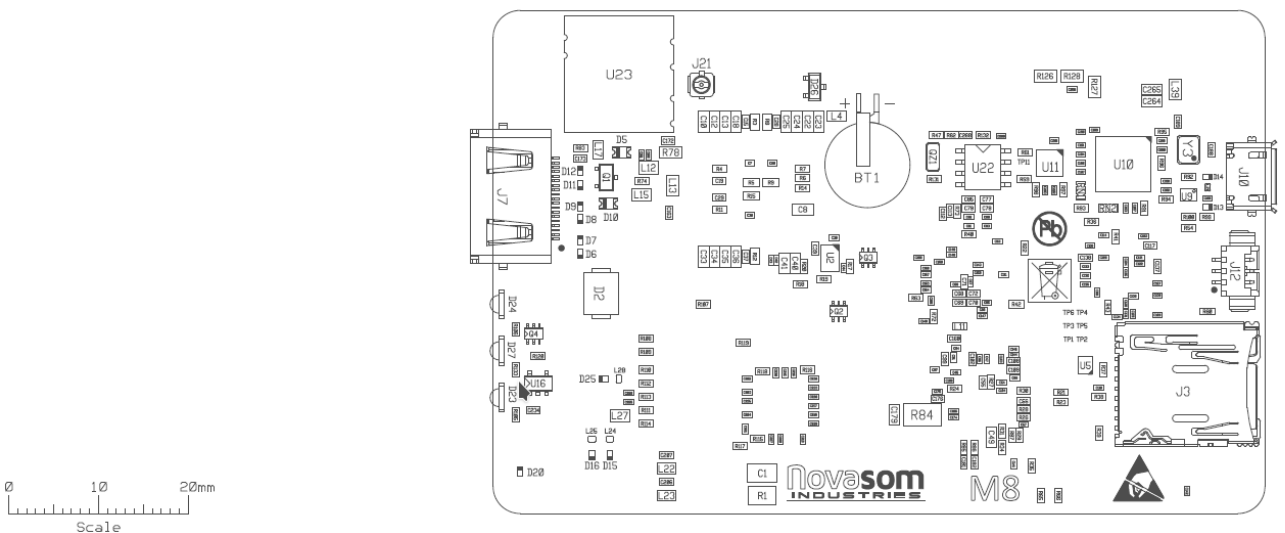


Figure 2 : NOVASOM M8 bottom general view

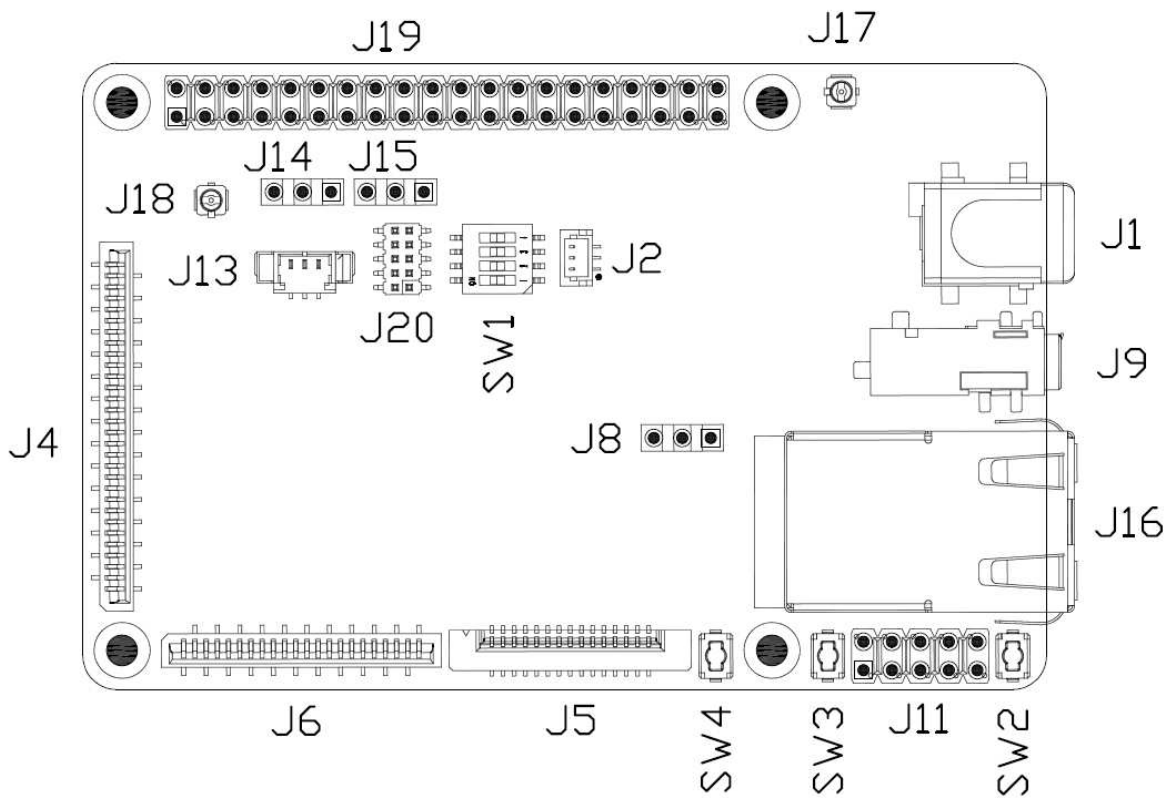


Figure 3 : NOVA som M8 connectors top view

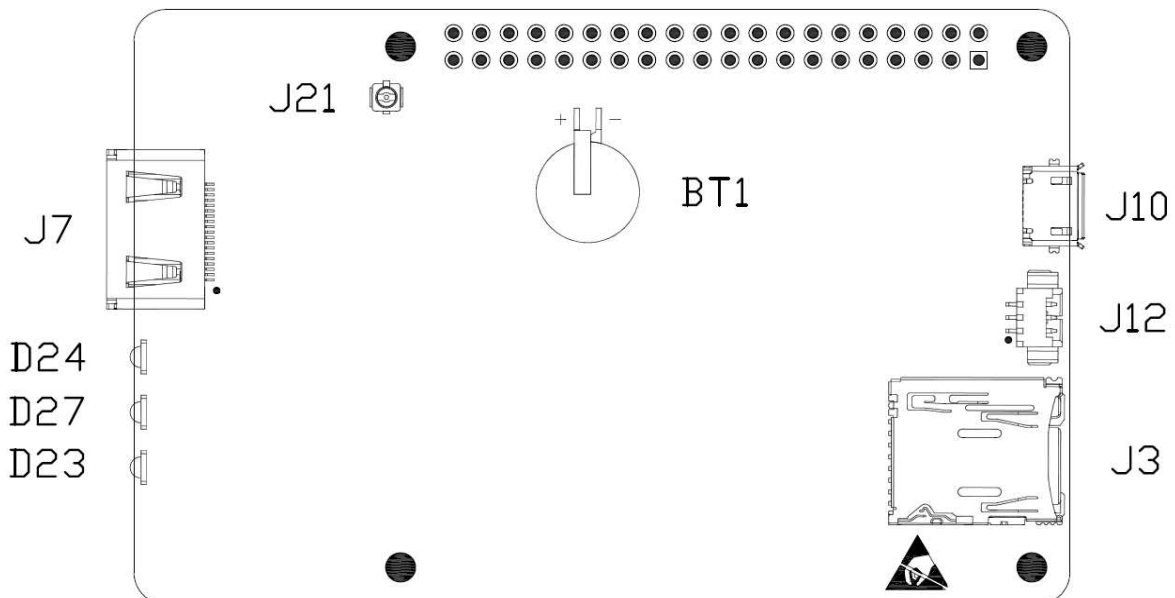


Figure 4 : NOVA som M8 connectors bottom view

In Table 1 you can see the NOVA som M8 board connectors and the mating connectors.

Connector	Manufacturer	Connector Part Number	Function
J1	CUI	PJ-002AH-SMT-TR	Power input
J2	JST	BM03B-SRSS-TB(LF)(SN)(P)	Backup Battery
J3	Hirose	DM3AT	μSD
J4	Molex	0528083070	CSI0
J5	Molex	0526101572	CSI1
J6	Molex	0528082270	DSI
J7	FCI	2-1903015-2	HDMI
J8	Molex	0022032031	Aux speaker
J9	CUI	SJ-43515RS-SMT	Audio jack
J10	FCI	10104111-0001LF	μUSB
J11	FCI	67997-410HLF	USB Exp
J12	Molex	53261-0371	Console
J13	Molex	53398-0371	Aux serial
J14	Molex	0022032031	Aux int/ext switch1
J15	Molex	0022032031	Aux int/ext switch2
J16	Amphenol	RJMG233022610ER	Eth + USB 2.0
J17	Hirose	U.FL-R-SMT-1	WiFi UFL (Not present)
J18	Hirose	U.FL-R-SMT-1	GPS UFL (Not present)
J19	-	-	40 Header Raspmod
J20	Sullins	GRPB052VWQS-RC	I2C exp
J21	Hirose	U.FL-R-SMT-1	FM In (Not present)

Table 1 : Connectors list

4.2 Connectors placement

In the Table 2 you can see the NOVASOM M8 board connectors layer position.

Identifier	Position
J1	Top
J2	Top
J3	Bottom
J4	Top
J5	Top
J6	Top
J7	Bottom
J8	Top
J9	Top
J10	Bottom
J11	Top
J12	Bottom
J13	Top
J14	Top
J15	Top
J16	Top
J17	Top
J18	Top
J19	Top
J20	Top
J21	Bottom

Table 2 : Connectors pinout

4.3 J19 Expansion Connector pinout

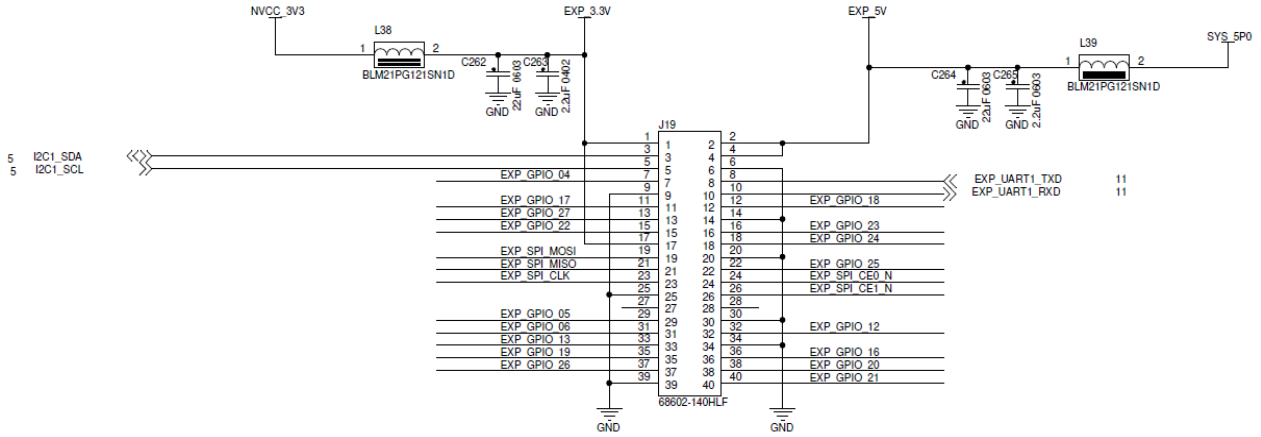


Figure 5 : J19 Details

4.4 J9 Audio Connector pinout

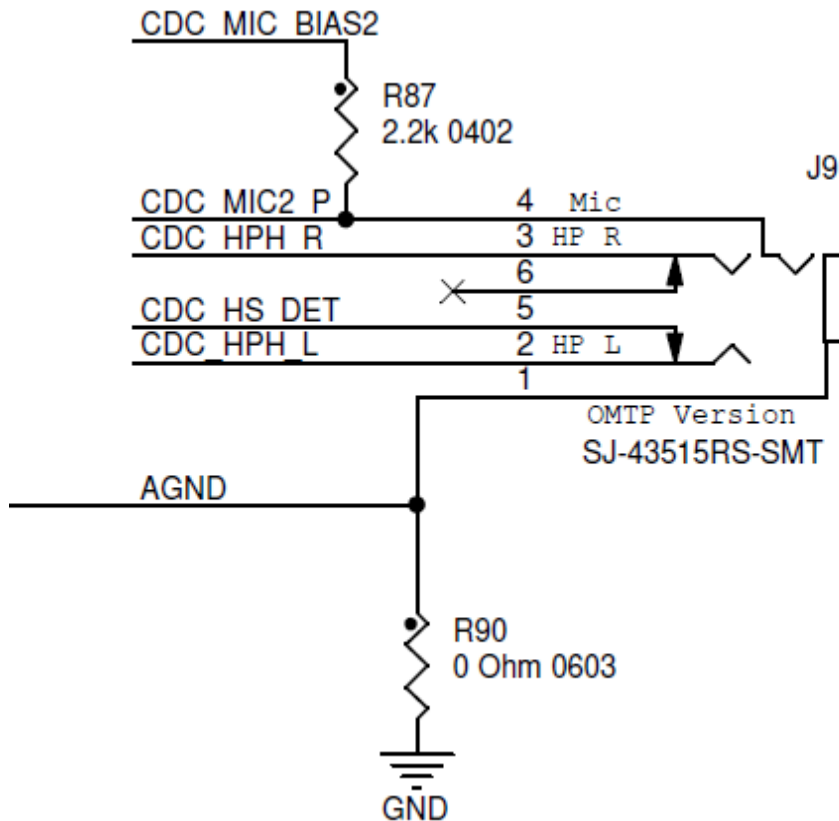


Figure 6 : Audio connector detail, default OMTP

4.5 J8 Audio External speaker pinout

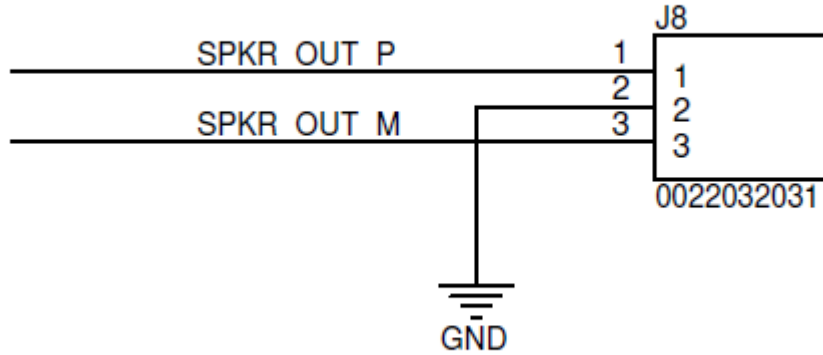


Figure 7 : Audio external connector detail

4.6 J11 USB External connector pinout

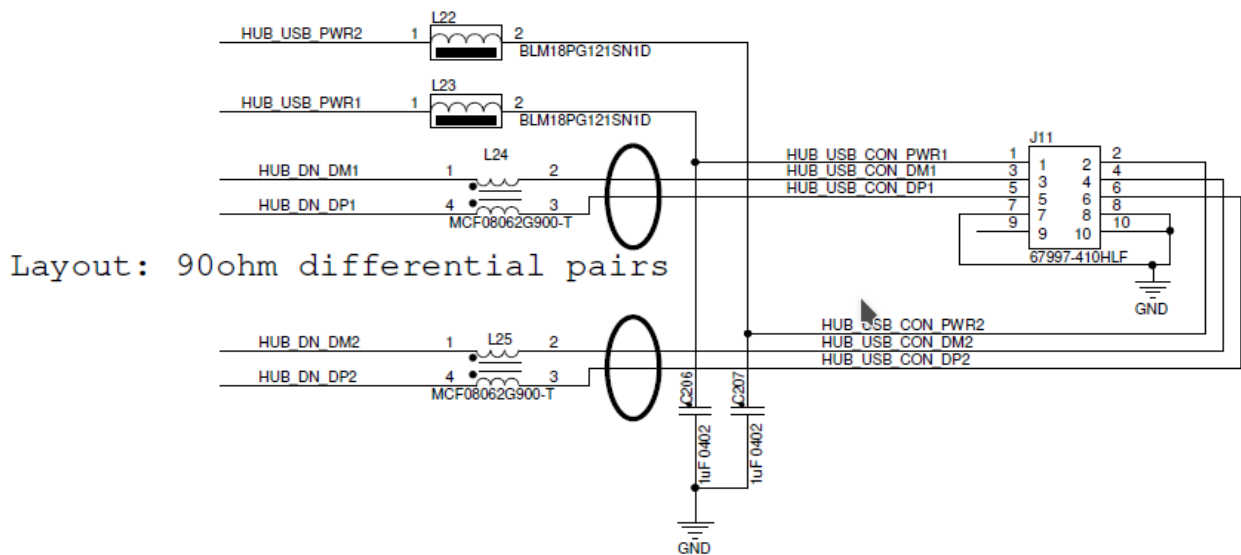


Figure 8 : USB external connector detail

4.7 J11 Console and AUX UART connector pinout

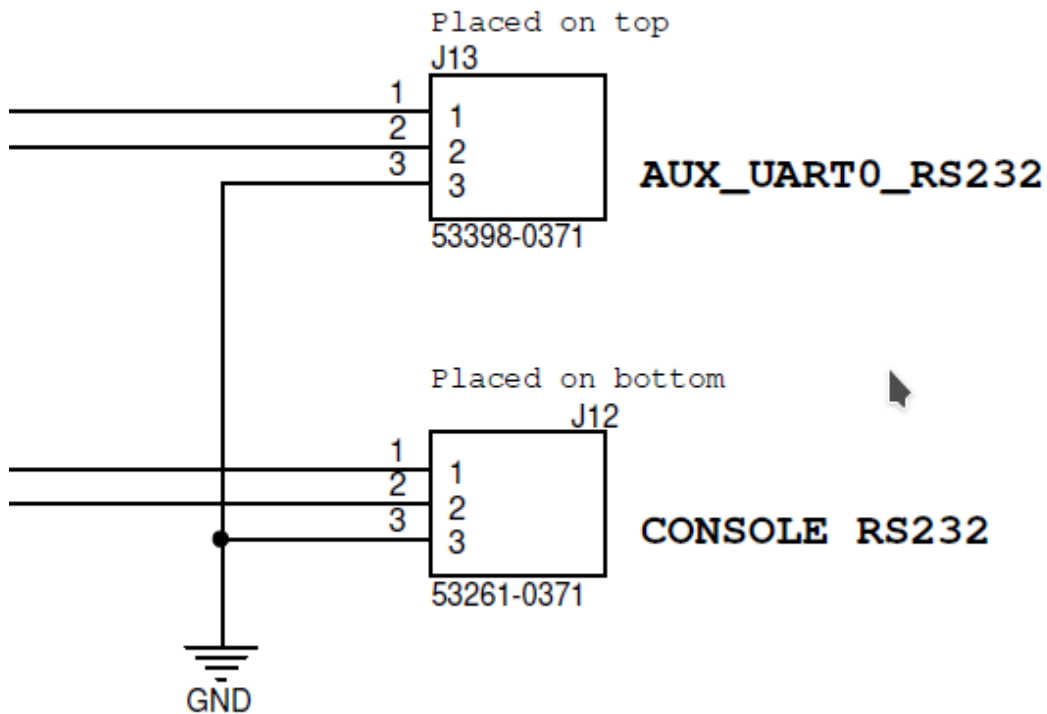


Figure 9 : Console and AUX UART external connector detail

4.8 J1 Power Input details

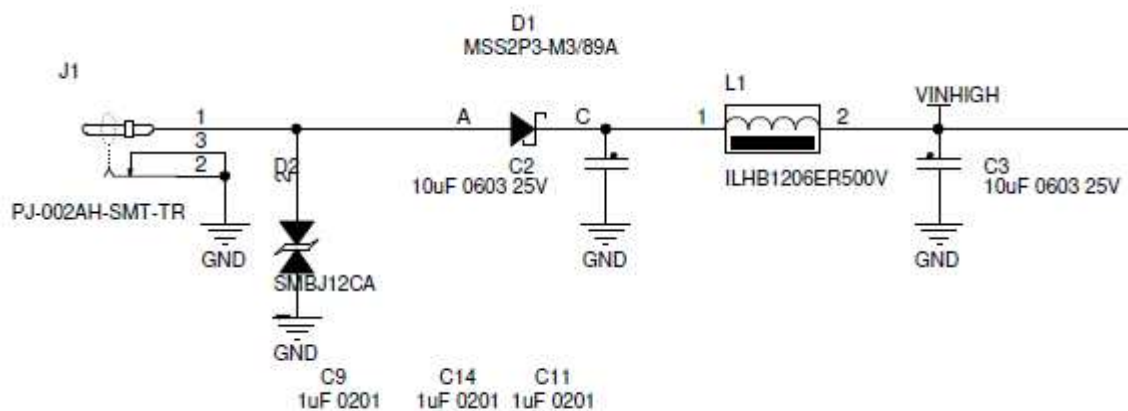


Figure 10 : Power input detail

4.9 Leds

The NOVA**som** M8 board is equipped with a total of 7 leds, 4 of them on the top side at the right of the processor area and the remaining 3 on the bottom side, just at the right of HDMI connector.

The 4 leds on the top side are connected to 4 general purpose GPIO, and in the default DTB the led D17 is used as the heartbeat indicator. The other 3 leds on the top (D18 , D21 and D22) are free for user.

On the bottom side there is the led D23 connected to the rfkill logic for LAN, D24 to the same logic for Bluetooth and D27 that is the power indicator.

5 : Electrical characteristic

5.1 Absolute maximum ratings

Over operating free-air temperature range (unless otherwise noted)(1)(2)

VINHIGH	6.5 to 13V (up to 18Vcc for t < 100 uSec.)
3.3V pin input voltage (2)	-0.3V to 3.6V
Battery Voltage Input	-0.3V to 4.7V
3.3V pin output voltage (2)	-0.3V to 3.6V
Input clamp current for 3.3V pin (2)	±10mA

Table 3 : Absolute maximum ratings

(1) Stresses beyond those listed under “Absolute maximum ratings” may cause permanent damage to the board. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under “Recommended operating conditions” is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect board reliability.

(2) The input and output voltage ratings may be exceeded if the input and output current ratings are observed.

5.2 Recommended operating conditions

VINHIGH	6.5V to 12.5 Vcc (up to 18Vcc for t < 100 uSec.)
3.3V pin input voltage (2)	0V to 3.3V
Battery Voltage Input	0V to 4.3V
3.3V pin output voltage (2)	0V to 3.3V
Input clamp current for 3.3V pin (2)	±2mA

Table 4 : Recommended operating conditions

5.3 Power consumption and power dissipation

All measurements are done with an input voltage of 12V with Android 5.1 and an HDMI monitor @ 1920x1080.

- Boot phase : 200 mA
- Running : 170 mA Suspend to memory : 110 mA
- Freeze to memory : 20 mA

For the details of the low power modes consult the Rockchip RK3328 Reference Manual

5.4 USB relevant standards

- Universal Serial Bus Specification, Rev. 2.0 (Compaq, Hewlett-Packard, Intel, Lucent, Microsoft, NEC, Philips; 2000)
- On-The-Go and Embedded Host Supplement to the USB Revision 2.0 Specification (Hewlett-Packard Company, Intel Corporation, LSI Corporation, Microsoft Corporation, Renesas Electronics Corporation, ST-Ericsson; 2012).

6 : Operational characteristics

6.1 : Development system requirements

From the NOVASOM Industries web site www.novasomindustries.com the user can download the NOVASOM SDK to ease the development process for all the NOVASOM Industries boards.

The NOVASOM M8 board is currently supported at the boot level, and there is the standard BSP support in form of device tree blob, or DTB.

The NOVASOM SDK is a virtual machine tool, running on a Fedora 20 core and based on VirtualBox.

The Virtual Machine is thus compatible with hosts based on Windows™, MacOS™ or Linux machines.

More detailed information about the installation process of the NOVASOM SDK can be found visiting the NOVASOM Industries web site at www.novasomindustries.com.

Normally, for a relatively relaxed development, an I5 host with 60 GBytes of free hard disk space and 8GBytes of RAM is enough.

For very heavy developments (as a complex 3D supported Qt file system or a Chromium X based application) “the bigger is better”, so more RAM you can dedicate to the Virtual Machine the faster the Virtual Machine will run.

A more than good situation is an I7 host with 16GB of RAM and 128GB of free disk space.

For connecting to the NOVASOM M8 console you need a serial port, and considering that on modern desktop the serial port is not present a USB to Serial adapter is probably the only choice you have.

Finally, you need a written with a basic file system, and a way to physically write the µSD itself.

You can download a µSD image from the www.novasomindustries.com page in the NOVASOM M8 dedicated section, where you can find all the information about how to write a µSD from the NOVASOM M8 image you just downloaded using your preferred host system.

6.2 : The NOVASOM M8 console

In order to use the serial console available on the NOVASOM M8 board you need a serial terminal.

GtkTerm is a good choice for Linux users, Teraterm is a nice choice for Windows™ users, it’s up to MacOS™ users to understand which kind of terminal application they need.

The NOVASOM M8 port is on pins 8 and 10 of J9 connector at 3.3V level. An external translator or an external USB to serial converter is required. NOVASOM Industries can provide a suitable adapter (see code 240718) to drive the pins adequately. A serial port with a bit rate of 115200 with no flow control and 1 stop bit is required to communicate with the NOVASOM M8 board.

The pins from where to connect the serial port are pin 8 of J9 (TXD from NOVASOM M8 board) , pin 10 of J9 (RXD to NOVASOM M8 board) and pin 6 of J9 (the GND connection).

Just plug both the power supply and the serial port through the adapter and you will see the boot process of your new NOVASOM M8 board.

6.3 : The first boot

The first thing to do is set appropriately the dip switch SW1 (located on top) as in figure 8 :

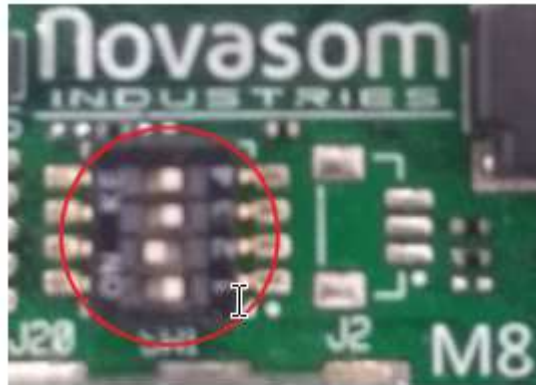


Figure 11 : DIP SW Settings

With these settings the board will boot from μ SD.

The steps in order to boot your NOVASom M8 board are :

- Create the μ SD with a standard file system as described in chapter 6.1 above
- Insert the just written μ SD in the J3 slot
- Connect the serial port to your NOVASom M8 and a FHD capable monitor the the HDMI (J7 connector)
- Insert an appropriate power source chord in the J1 connector and power it on.

A special note about the μ SD slot : the μ SD slot has not been designed to insert or remove the μ SD card with power applied, so inserting or removing a μ SD card with applied power may result in a permanent damage to the card or, worst, to the NOVASom M8 board.

The card MUST be inserted without power applied.

The presence switch that equips the μ SD slot of the NOVASom M8 board signals to the processor that a card is in the slot, thus allowing the boot process to read the boot loader from the μ SD slot.

If the card is not found when the power is applied the boot process will look in eMMC chip (if present) for a valid boot loader code, but remember that the presence of the qSPI chip depends on the NOVASom M8 board configuration.

6.4 : Connections to J19

J19 sports a lot of signals, and most of them are connected at the processor level without buffering or protection.

Although the processor is quite protected on over and under voltages, care should be taken in order to avoid to stress the processor outside the recommended operating conditions, or permanent damages will result on the processor itself.

It's quite common to overtake a ringing digital signal that stresses the processor outside the recommended operating conditions, so if you are in doubt use dump series resistors in the order of 1 K Ω for input signals. In the table 2 the signals are named as the standard DTB factory functions, and the colored functions are the functions provided by the standard DTB factory functions.

You can find all the information on how to change a pin function visiting the www.novasomindustries.com page in the NOVA**som** M8 dedicated section, where you can find a lot of application notes and already developed tools and examples.

6.5 : Connecting an external battery to the NOVAsom** M8 board**

The connector J2 is minded to connect a 3.7V external battery.

The external battery will be used on systems that need to be powered by an external battery.

On the other hand, the battery can be of a rechargeable type (Lilon or Lithium coin cell) and will be charged with 450 mA from the 5V supply.

Care should be taken to connect the correct battery (a 3.7V battery is requested, higher voltages will immediately destroy your NOVA**som** M8 board) and connect the battery in the correct way, where the pin 1 of J2 is the positive and the pin 2 is the negative. A power inversion can permanently damage the battery or, worst, damage your NOVA**som** M8 board.

6.6 : Developing a NOVASOM M8 extension board

The APQ8016 contains a limited number of pins, most of which have multiple signal options. These signal to pin and pin to signal options are selected by the input/output multiplexer called IOMUX.

The IOMUX is also used to configure other pin characteristics, such as voltage level, drive strength, and hysteresis.

Due to this, all the I/O pins on J19 behave as input at power up, and until the bootloader or the kernel are up and running, they are substantially configured as input.

All the inputs have an internal 100kΩ pull up to the VCC rail, whichever the VCC is.

Keeping this in mind, all the pins that are configured to be an output needs a pull down resistor in the range of 15kΩ in order to keep the particular signal at the low level, if needed.

This is true for all the I/O.

The following Table 5 indicates the recommendations of the I2C special function pin.

Signal Group	Recommendations
I2C buses : I2C2_SCL, I2C2_SDA	No particular attention. The pull up resistor are on board, so they are not needed

Table 5 : Groups recommendations

Here there are some basic rules for the correct interfacing to J19:

- Don't overdrive an input pin : all the pins have a 3.3V logic. Avoid to drive a normally powered 3.3V pin with values that exceeds those defined in Table 4 : Recommended operating conditions.
- Pay attention to overshoot or undershoot, and if present use a damp resistor in the range of 100 Ω to 1K Ω in series. The internal protection of the RK3328 will do the rest.
- Understand the idle logic level (e.g. during reset) and use the appropriate pull up or pull down if needed, in the range of 15kΩ. The RK3328 processor has an internal pull up of 100 kΩ at power up on all I/O pins, so during the reset phase and for all the boot phases the I/O pins of the RK3328 will float high. For example, if you drive an external load activated with a low level, you will get a logic one on the I/O pin until the kernel has not defined this is an output pin (some 5 to 12 seconds after power is applied, depending on file system size), so you will have your load activated during all the boot phases.
- Avoid short circuits between pins or between pins and power, even for limited time. Although the RK3328 is quite well protected, this rises power dissipation, may lead to pin breaks or worst and in any case is not a good practice.
- Select the right output strength in the DTB file of your BSP and avoid using excessive strength for signals that don't need this. Also, consider carefully the FAST output mode, as this leads to EMI problems and ring on not well matched traces.

- The I2C lines (I2C2_SCL, I2C2_SDA) has a 3.3K Ω pull ups on the NOVA**som** M8 board to their own power. Avoid to place additional pull ups on the I2C lines, as this may lead to malfunctioning due to excessive load.
- The USB HOST channels on J11 (HUB_USBCON signals) has no power protections and management on the the NOVA**som** M8 board .

With these simple hints you will successfully design your own Extension board.

7 : Troubleshooting

Here you can find a very basic list of things that can happen at the unexperienced user at the very first boot.

In case of hardware failure contact us at www.novasomindustries.com for additional support and follow carefully the instructions.

<p>Power is applied but I can't see anything on the terminal output.</p>	<ul style="list-style-type: none"> • Check your μSD has been correctly inserted in J3 slot and power is applied. • Check your μSD has been correctly written. The μSD has an initial FAT partition, so you can check if it's correctly written on a Windows™, MacOS™ or Linux machine. If you can't read the μSD this means it is broken or badly written, try to rewrite it or substitute it with a new one. • Check if the green led D27 (power) is on. If it's not on check your power supply voltage, current and wire orientation. Protections on the NOVAsom M8 board permit you to connect an inverted power, but not on overvoltage, so be careful. An undervoltage situation will not damage the NOVAsom M8 board, an overvoltage will damage your NOVAsom M8 board for sure. • Check if the green led D17 (heartbeat) blinks. If the steps above are checked this should indicate an hardware failure. • Check the connection with your serial port or the application you use as a terminal are correct. If still you don't find anything wrong this should indicate an hardware failure.
<p>I see the terminal but I have no connection with the network</p>	<p>Check your cables and your connectivity, maybe you need to ask your network administrator. The NOVAsom M8 base image has a dhcp client active, so you need an accessible dhcp server to effectively use the network interface. If still you don't find anything wrong this should indicate an hardware failure.</p>

<p>I can't see any video on the HDMI monitor</p>	<ul style="list-style-type: none"> • Check your DTB has a correct description of the HDMI panel and the timings. • If still you don't find anything wrong and you are sure your panel is not broken this should indicate an hardware failure.
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Table 6 : Troubleshooting

8 : Contacts

Web page : www.novasomindustries.com

9 : Document revisions, references and notes

9.1 Document revisions

N.M8-091116-HUM-V1.0	First release
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9.2 External references

For the NOVA**som** Industries products and NOVA**som** M8 in detail : www.novasomindustries.com

For the processors : Rockchip APQ8016 Applications Processor Reference Manual

9.3 Notes

Information contained in this publication regarding device applications and the like is provided only for your convenience and may be superseded by updates.

It is your responsibility to ensure that your application meets with your specifications.

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