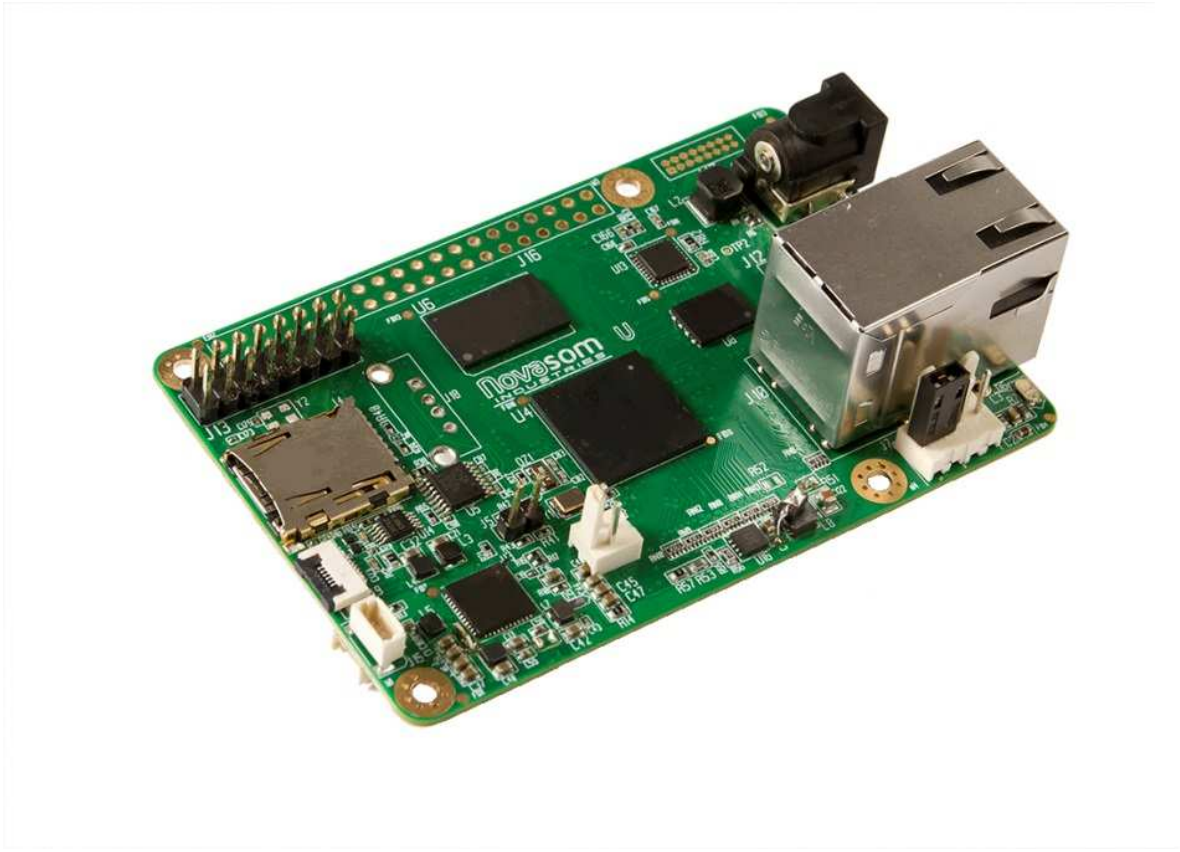
NOVAsomU5



Hardware User Manual

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1 : Welcome to the NOVAsom U5 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- Default applications on the device are subject to updates, and support for these applications may be withdrawn without prior notice.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 U5 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 U5 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 standard products with different configurations is available:

• NOVAsomU5C: with processor NXP® iMX6ULL @1GHz,512MB RAM DDR3

This list is only an example and 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 NOVAsom U5 are:

On Board Peripherals:

- Up to 1GBytes 16 bit wide DDR
- 1 bootable uSD slot up to 32GBytes
- 1 Ethernet port @ 10/100 Mbit/sec.
- 1 1366x768 rgb video output port
- 1 Integrated RTC with optional external battery connector
- Audio codec with HP Output - 62.5 mW max, 1.02 kHz sine into 16 Ω load, 100dB SNR (-60dB input) and -80 dB THD+N (16 Ω load, DAC to headphone) and LINEOUT - 100dB SNR (-60dB input) and -85 dB THD+N
- 1 USB Host connector
- 1 Remote IR input with optional connector
- 1 Power led and 1 User Driven led
- 3.5mm Jack audio connector
- Standard 2.5mm Power Supply Jack for 6.5Vcc to 12Vcc input, central positive
- WiFi / BlueTooth USB connected module with dual UFL antenna connector

On Expansion Connectors (J16):

- 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 uSD/eMMC plus 3 GPIO
- 1 x TX/RX only UART

On Additional Expansion Connectors (J13):

- 1 x RS232 (Note 2)
- 1 x optional RS485 with transceiver and optional termination (Note 2)
- External On/Off control (Note 1)
- USB OTG Port (Note 1)

On IR Expansion Connectors (J15):

- Input from IR detector (Note 1) (Note 2)
- Output led for IR feedback (Note 1) (Note 2)

Note 1 : these pins have a dedicated function and cannot be used as GPIO
Note 2 : these pins have the appropriate driver

All the pins without (Note 1) , (Note 2) or (Note 3) can be programmed as GPIO or programmed accordingly to the functions described in table 6 and table 7 below.

The connectors J16 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 NOVAsom U5, use partially populated connectors or a mix of them.

3 : Description

The NOVAsom U5 family is equipped with iMX6 ULL processor , up to 1GByte DDR3L and WiFi/BT, 100 Mbps Ethernet with magnetic connector on board and PI compatible expansion connector. UPS-Manager© , WiFi, qSPI memory and other options are available on request.

Visit www.novasomindustries.com , you can download 3D drawings and detailed mechanical drawing.

4 : Connectors description and Configuration

4.1 Connectors list and function

In Figure 2 you can see the NOVAsom U5 board connectors top placement, while in Figure 3 you can see the NOVAsom U5 board connectors bottom placement

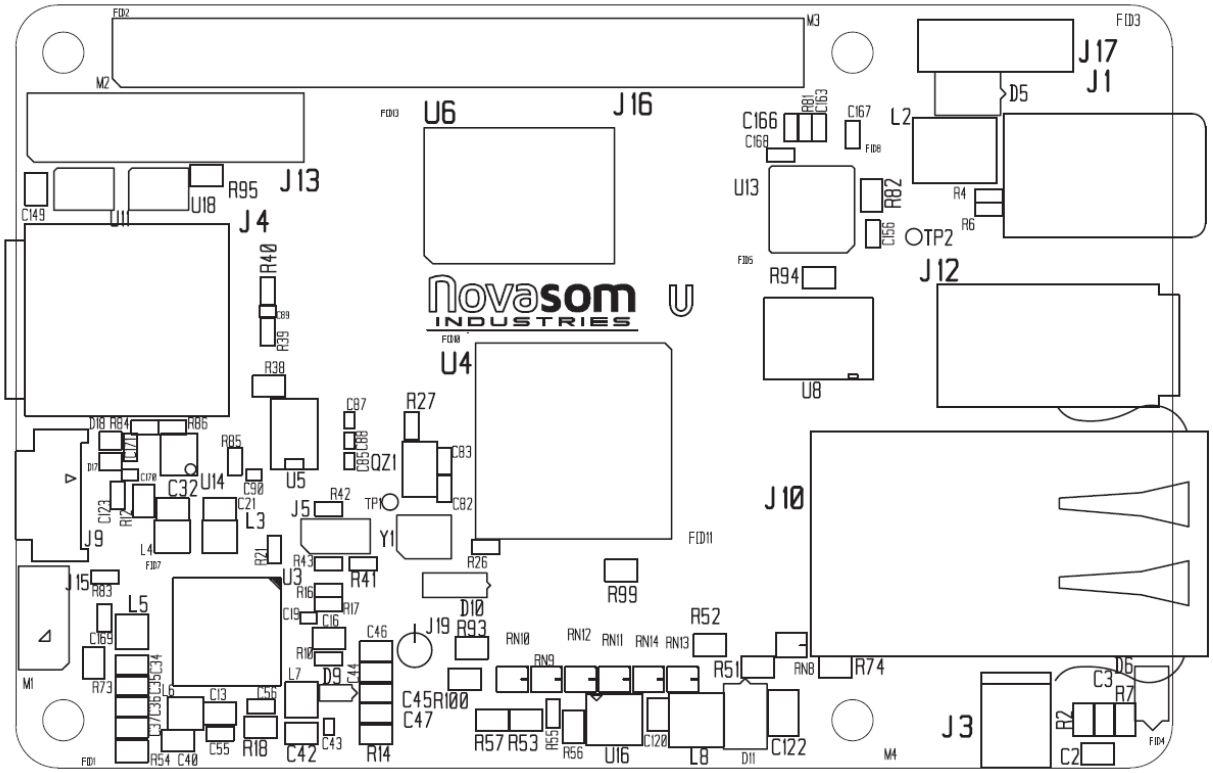


Figure 1 : NOVAsom U5 top view

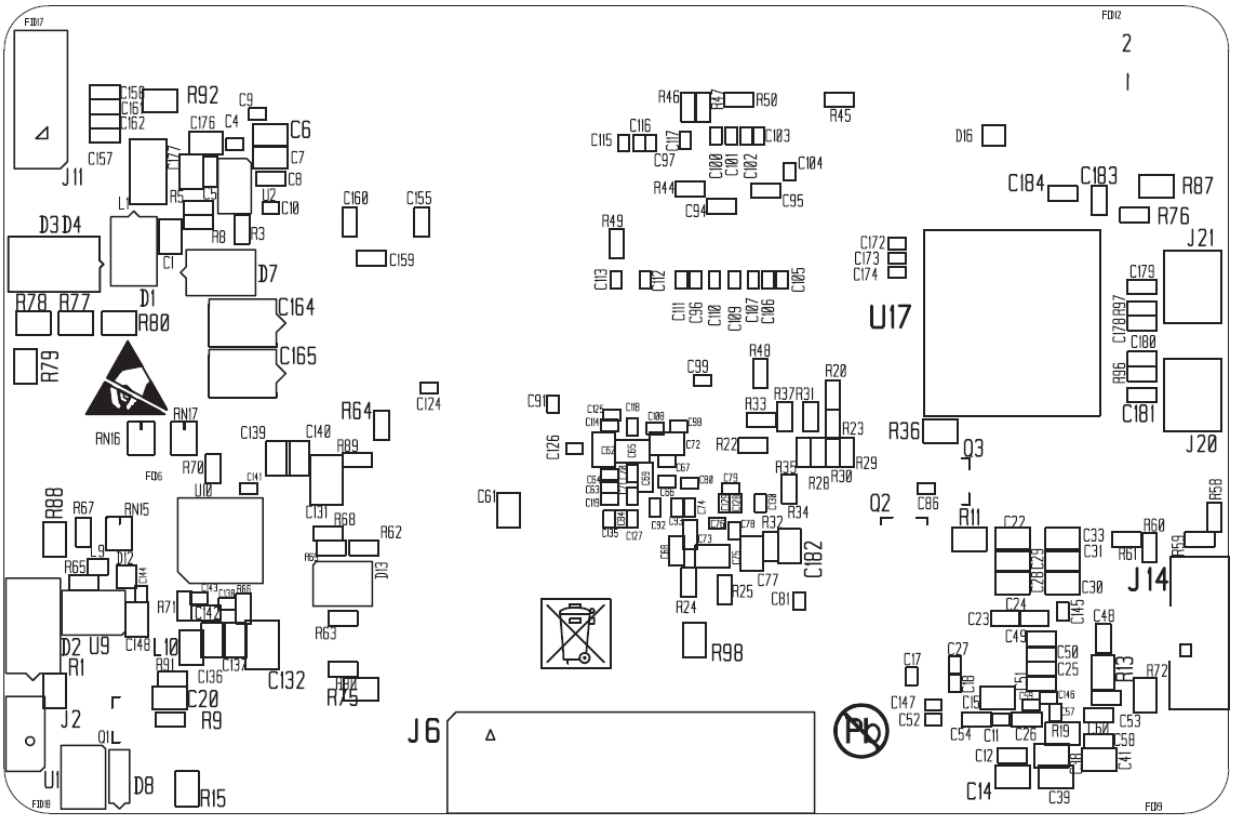


Figure 2 : NOVAsom U5 bottom view

4.2 Connectors pinout

In Table 1 you can see the NOVAsom U5 board connectors and the mating connectors.
The connectors marked with "-" are for internal use only.

Connector	Manufacturer	Connector Type	Function
J1	CUI	PJ-002AH-SMT-TR	POWER
J2	JST	BM02B-SURS-TF(LF)(SN)	External battery
J3	-	-	-
J4	HIROSE	DM3AT-SF-PEJM5	µSD
J5	-	-	-
J6	AMPHENOL	62684-401100ALF	LCD (RGB)
J9	MOLEX	5051100692	PCAP
J10	Abracon	ARJE-0032	Ethernet+USB
J11	MOLEX	53261-0671	Line audio
J12	CUI		Audio
J13	-	-	-
J14	MOLEX	53261-0371	Console
J15	JST	BM04B-SRSS-TB(LF)(SN)	IR
J16			40 pin header
J17	-	-	-
J19	-	-	-
J20	HIROSE	U.FL-R-SMT-1	UFL Antenna
J21	HIROSE	U.FL-R-SMT-1	UFL Antenna NU

Table 1 : Connectors pinout

In the Table 2 you can see the NOVAsom U5 board connectors functions and pin assignement.

Connector	Manufacturer	Connector P/N	Function	Pinout	Signal Name
J15	JST	BM03B-series	IR Detector	4	IR_DETECT
				3	3.3V
				2	GND
				1	IR FEEDBACK
J10	Abracon	ARJE-0032	Ethernet+USB	See ARJE-0032 datasheet	
J1	CUI Inc.	PJ-002AH-SMT-TR	POWER	1	VIN
				2	GND
J4	Hirose	uSD card	uSD	1	DATA2(*)
				2	DATA3(*)
				3	CMD(*)
				4	VDD(*)
				5	CLK(*)
				6	VSS(*)
				7	DATA0(*)
				8	DATA1(*)
J2	JST	BM02B-SURS-TF(LF)(SN)	Battery	1	VBAT+

				2	GND
J16	NP		40 pin header	See below	

Table 2 : Connectors pinout

(*) Note : the uSD slot is 3.3V powered and has no provisions to manage the insertion or the removal of the uSD card with power applied, and thus no ESD protections equip the uSD slot.
The insertion or the removal of a uSD card with applied power may result in a permanent damage to the card or, worst, to the NOVAsom U5 board.
The card MUST be inserted without power applied.
The presence switch that equips the uSD slot of the NOVAsom U5 board signals to the processor that a card is in the slot, thus allowing the boot process to read the bootloader from the uSD slot.
If the card is not found when the power is applied the boot process will look in eMMC chip for a valid bootloader code but the presence of the eMMC depends on the NOVAsom U5 board equipment.
The uSD slot is a push-push operated slot.
Removing the uSD card without pushing will result in mechanical failure of the slot itself.

4.3 J16 Expansion Connector pinout

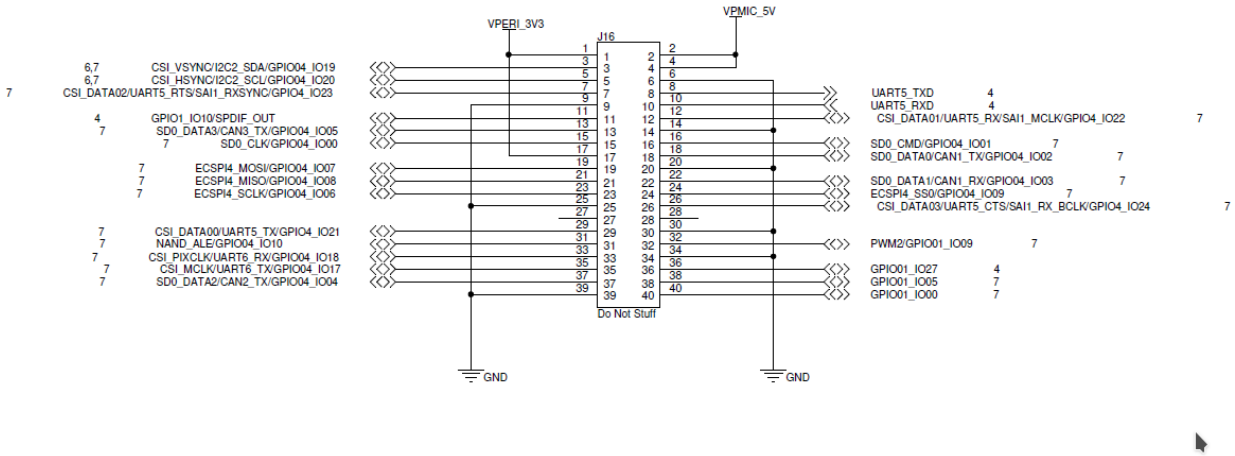


Figure 3 : J16 Details

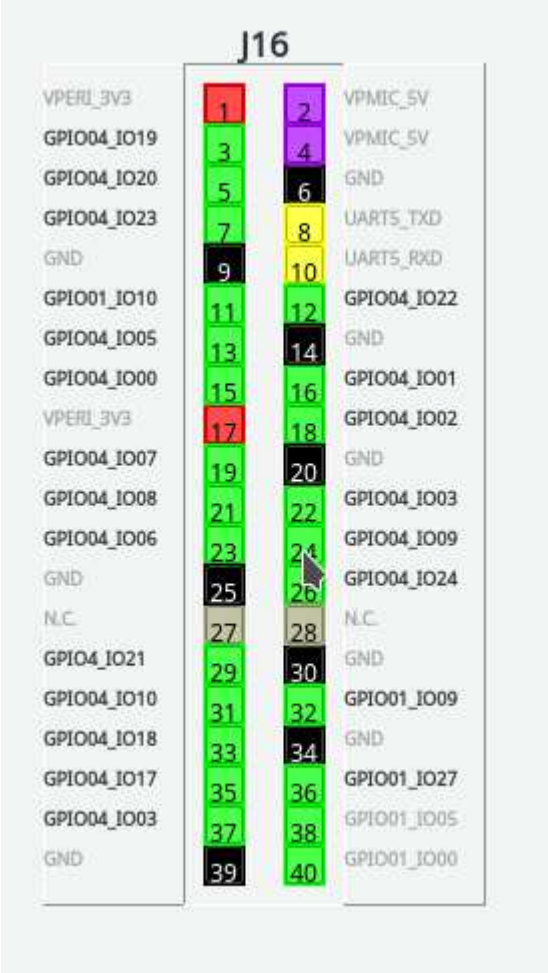


Table 3 : J16 Connectors pinout

4.4 J6 LCD Connector pinout

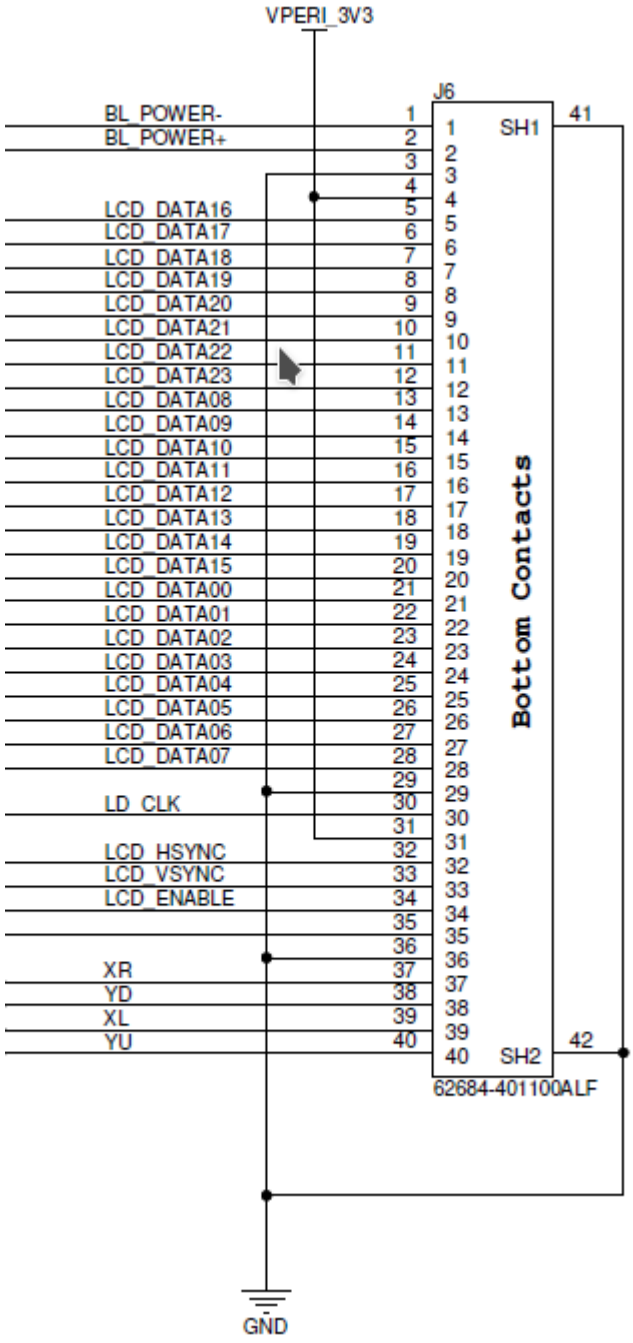


Figure 4 : J6 LCD Connectors pinout

4.5 J13 Additional Expansion Connector pinout

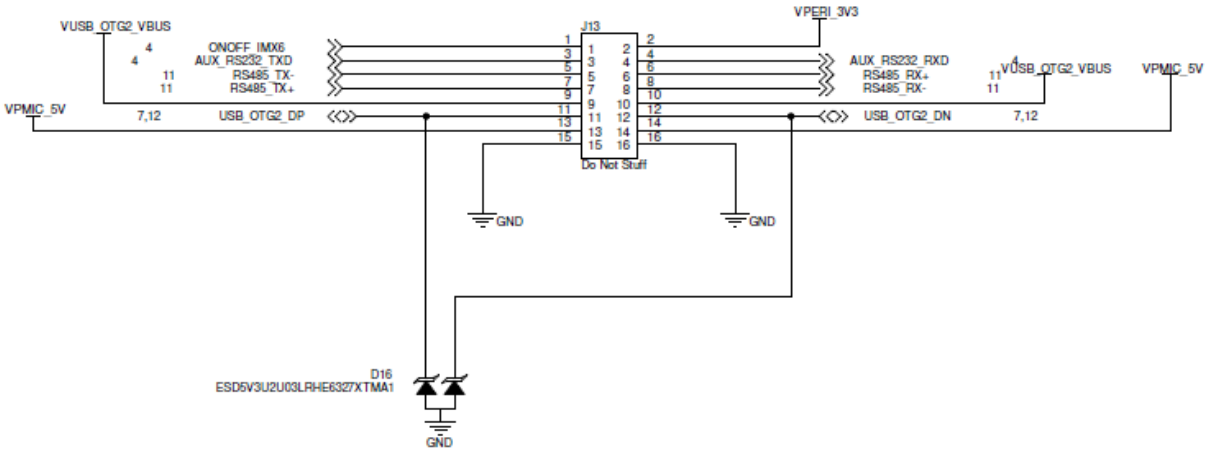
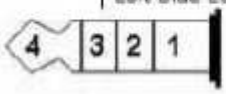


Figure 5 : J13 detail

4.6 J12 Audio Connector pinout

OMTP 'AV' Connector Interface		AHJ 'AV' Connector Interface	
PIN	Description	PIN	Description
1	Ground	1	Microphone
2	Microphone	2	Ground
3	Right Side Earpiece	3	Right Side Earpiece
4	Left Side Earpiece	4	Left Side Earpiece



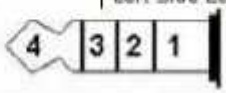


Figure 6 : Audio connector detail, default OMTP

5 : Electrical characteristic

5.1 Absolute maximum ratings

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

VINHIGH	6.5 to 18V (up to 21Vcc for t < 100 uSec.)
3.3V pin input voltage (2)	-0.3V to 3.6V
Battery Voltage Input	-0.3V to 3.6V
3.3V pin output voltage (2)	-0.3V to 3.6V
Input clamp current for 3.3V pin (2)	±10mA
Dedicated pin : RS232	±15V

Table 4 : 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 21Vcc for t < 100 uSec.)
3.3V pin input voltage (2)	0V to 3.3V
Battery Voltage Input	0V to 3V
3.3V pin output voltage (2)	0V to 3.3V
Input clamp current for 3.3V pin (2)	±2mA
Dedicated pin : RS232	±12V
Power drawn from LCD power	50mA
Power drawn from LCD backlight	150 mA @ 20V

Table 5 : Recommended operating conditions

5.3 Power consumption and power dissipation

All measurements are done with an input voltage of 12V with a Base file system and a 1366x768 LCD panel with 20 mA of backlight current.

- Boot phase : 80 mA
- Running : 120 mA Suspend to memory : 110 mA
- Standby to memory : 20 mA (Backlight off)
- Freeze to memory : 20 mA (Backlight off)

For the details of the low power modes consult the NXP i.MX 6ULL Applications Processor 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 U5 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 aboaut 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 U5 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 uSD written with a basic file system, and a way to physically write the uSD itself.
You can download a uSD image from the www.novasomindustries.com page in the NOVAsom U5 dedicated section, where you can find all the information about how to write a uSD from the NOVAsom U5 image you just downloaded using your preferred host system.

6.2 : The NOVAsom U5 console

In order to use the serial console available on the NOVAsom U5 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 U5 port is a standard RS232 serial port with a bit rate of 115200 with no flow control and 1 stop bit.
The pins from where to connect the serial port are pin 1 of J11 (TXD from NOVAsom U5 board), pin 2 of J11 (RXD to NOVAsom U5 board) and pin 3 of J11 (the GND connection), respectively connected to the pins 2 ,3 and 5 of a 9 pins DB connector, normally found on USB to Serial adapters.
Just plug both the power supply and the serial port and you will see the boot process of your new NOVAsom U5 board.

6.3 : The first boot

The steps in order to boot your NOVAsom U5 board are :

- Create the uSD with a standard file system as described in chapter 6.1 above
- Insert the just written uSD in the J4 slot (note this is a push-push connector, avoid to extract the uSD forcing it or you can break the J4 uSD slot)
- Connect the serial port to your NOVAsom U5
- Insert an appropriate power source chord in the J5 connector and power it on.

After just some half a second you should see on your terminal application something similar to what you see in Figure 7 below, and this means you have your NOVAsom U5 powered up and running.

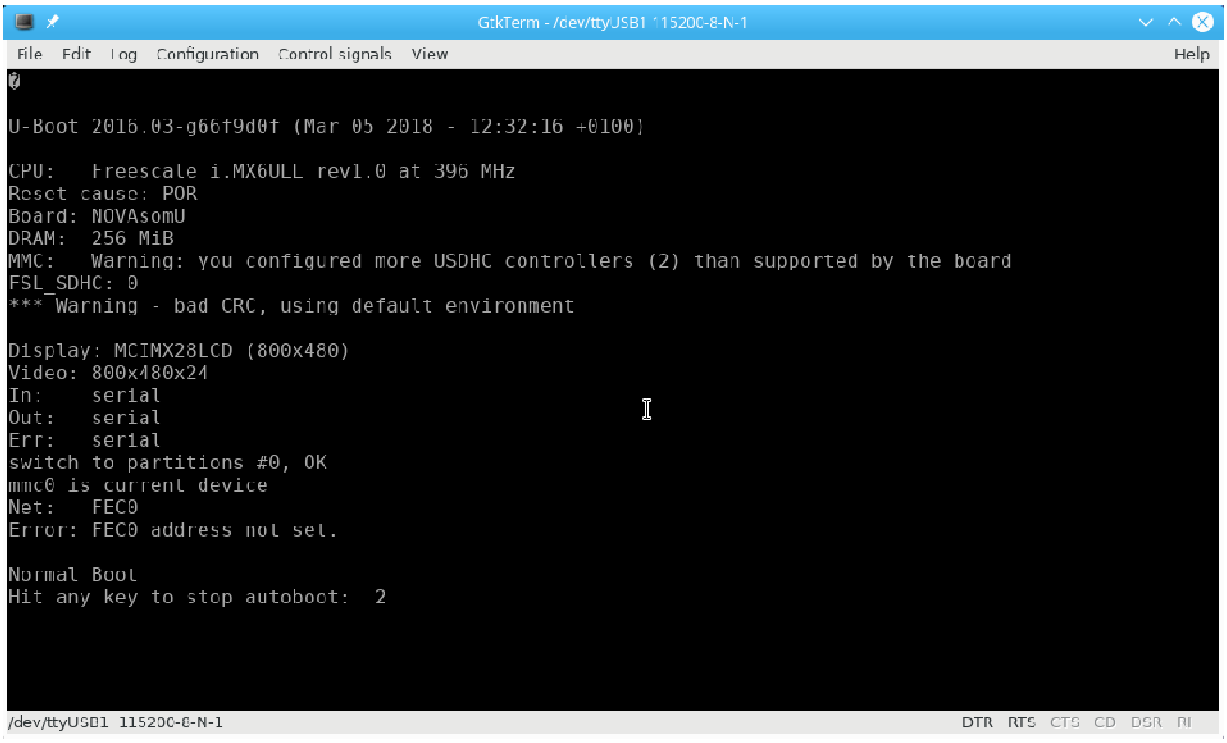


Figure 7 : The NOVAsom U5 first boot

A special note about the uSD slot : the uSD slot has not been designed to insert or remove the uSD card with power applied, so inserting or removing a uSD card with applied power may result in a permanent damage to the card or, worst, to the NOVAsom U5 board.
The card MUST be inserted without power applied.
The presence switch that equips the uSD slot of the NOVAsom U5 board signals to the processor that a card is in the slot, thus allowing the boot process to read the boot loader from the uSD slot.
If the card is not found when the power is applied the boot process will look in qSPI chip (if present) for a valid boot loader code, but remember that the presence of the qSPI chip depends on the NOVAsom U5

board configuration.

6.4 : Connections to J16

J16 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 KΩ 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 NOVAsom U5 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 U5 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 (LiIon 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 NOVAsom U5 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 NOVAsom U5 board.

6.6 : Developing a NOVAsom U5 extension board

The i.MX 6ULL 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 J16 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 pins marked with the green or orange box in Table 3 for J16.

The following Table 10 indicates the recommendations of the special function pin.

Signal Group	Recommendations
USB: USB_OTG_DP, USB_OTG_DN, USBDN_DP2, USBDN_DM2, USBDN_DP3, USBDN_DM3 : 90 Ω impedance	• Route the high speed clocks and the DP and DM differential pair first. • Route DP and DM signals on the top or bottom layer of the board • The trace width and spacing of the DP and DM signals should be such that the differential impedance is 90 Ω. • Route traces over continuous planes (power and ground). — They should not pass over any power/GND plane slots or anti-etch. — When placing connectors, make sure the ground plane clearouts around each pin have ground continuity between all pins. • Maintain the parallelism (skew matched) between DP and DM; these traces should be the same overall length. • Do not route DP and DM traces under oscillators or parallel to clock traces and/or data buses. • Minimize the lengths of high speed signals that run parallel to the DP and DM pair. • Keep DP and DM traces as short as possible. • Route DP and DM signals with a minimum amount of corners. Use 45-degree turns instead of 90-degree turns. • Avoid layer changes (vias) on DP and DM signals. • Do not create stubs or branches. • Ferrite beads should NOT be placed on the USB D+/D– signal lines as this can cause USB signal integrity problems. For radiated emissions problems due to USB, a common mode choke may be placed on the D+/D– signal lines. However, in most cases, it should not be required if the PCB layout is satisfactory. Ideally, the common mode choke should be approved for high speed USB use or tested thoroughly to verify there are no signal integrity issues created.
MIPI DSI: DSI_D0M, DSI_D0P, DSI_D1M, DSI_D1P, DSI_CLK0M, DSI_CLK0P : 100 Ω impedance	

Driver based logic : CONSOLE_RS232_TXD, CONSOLE_RS232_RXD	No particular attention
I2C buses : I2C2_SCL, I2C2_SDA	No particular attention. The pull up resistor are on board, so they are not needed

Table 6 : Groups recommendations

Here there are some basic rules for the correct interfacing to J16:

- 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 9 : 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 i.MX6ULL 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 i.MX6 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 i.MX6 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 i.MX6 is quite well protected, this rises power dissipation, may lead to pin breaks or worst and in any case is not a good practice.
- Check thoroughly the impedance matching and trace lengths on the "special" signals listed in Table 10.
- 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.

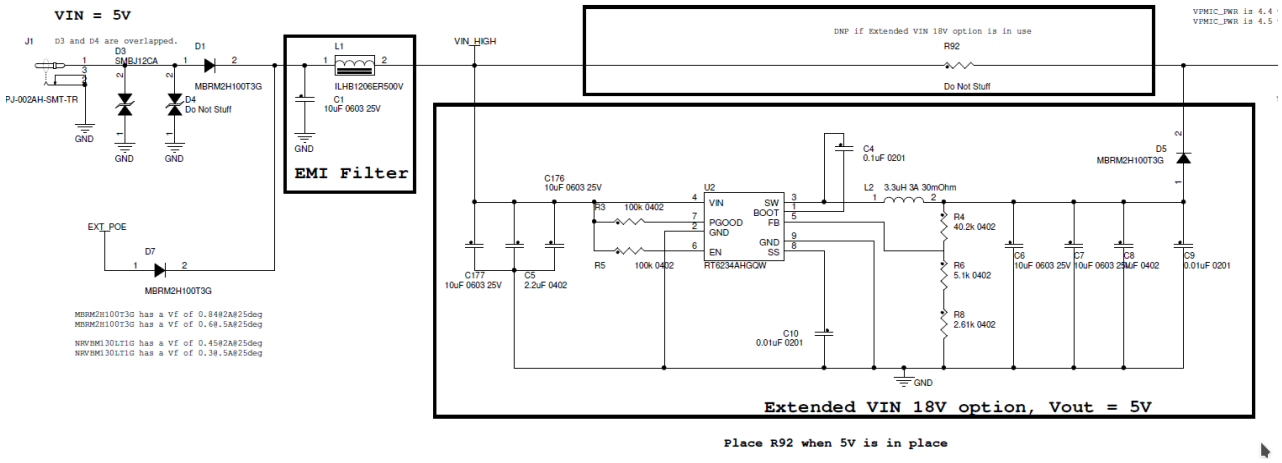


Figure 8 : Power input section

- The I2C lines (I2C2_SCL, I2C2_SDA) has a 3.3KΩ pull ups on the NOVAsom U5 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 J13 (USBDN_DP2, USBDN_DM2, USBDN_DP3, USBDN_DM3) has already the power protections and management on the the NOVAsom U5 board , and can be driven using a schematic like the one in the following Figure 5 (USBOTGDN, USBOTGDP is shown, but the same can be used for USBDN_DP3, USBDN_DM3 with the USB_PWR3 signal).

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

7 : Board outline and mechanical dimensions

Detailed drawings, 3D drawings, full mechanical specifications and additional information can be found visiting the www.novasomindustries.com page in the NOVAsom U5 dedicated section or contacting the appropriate sales person or distributors.

8 : Trobleshooting

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.

Power is applied but I can't see anything on the terminal output.	• Check your uSD has been correctly inserted in J4 slot and power is applied. • Check your uSD has been correctly written. The uSD 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 uSD this means it is broken or badly written, try to rewrite it or substitute it with a new one. • Check if the green led D11 (power) is on. If it's not on check your power supply voltage, current and wire orientation. Protections on the NOVAsom U5 board permit you to connect an inverted power, but not on overvoltage, so be careful. An undervoltage situation will not damage the NOVAsom U5 board, an overvoltage will damage your NOVAsom U5 board for sure. • Check if the green led D9 (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.
I see the terminal but I have no connection with the network	Check your cables and your connectivity, maybe you need to ask your network administrator. The NOVAsom U5 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.

I can't see any video on the LCD panel	Check your log (on the terminal the command is *dmesg | grep LCD)*. If the result doesn't contain *Detected LCD controller* check your DTB file
I can't see any video on the LVDS monitor	• Check the voltage levels for the LCD power supply and the backlight power supply. • Check your DTB has a correct description of the LCD panel and the timings. • Check your DTB defines correctly the PWM output. • If still you don't find anything wrong and you are sure your panel is not broken this should indicate an hardware failure.

Table 7 : Troubleshooting

9 : Contacts

Web page : www.novasomindustries.com

10 : Document revisions, references and notes

10.1 Document revisions

NI150316-HUM-P-V1.2	09/20/2018 Updates

10.2 External references

For the NOVAsom Industries products and NOVAsom U5 in detail : www.novasomindustries.com

For the i.MX processors : NXP i.MX 6ULL Applications Processor Reference Manual

NXP i.MX BSP Porting Guide

10.3 Notes

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