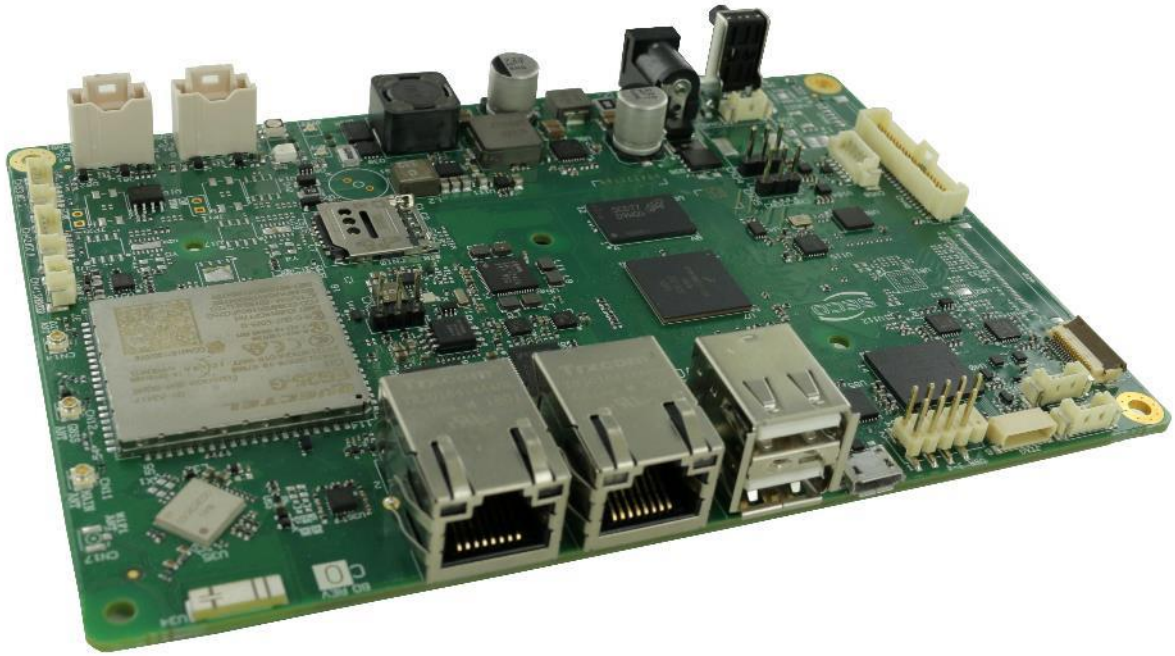
SBC

User Manual



ASTRID

(formerly codenamed SBC-C61)

Single Board Computer
with the NXP i.MX 8M Mini Processors
on 3.5” form factor

SECO

www.seco.com

REVISION HISTORY

Revision	Date	Note	Ref
1.0	20 April 2021	First Official Release.	SB
1.1	12 May 2021	Safety Policy chapter 1.4 updated Warning in Thermal Design chapter 4.1 updated	SB
1.2	15th December 2021	Declaration of rights updated eDP/LVDS resolution updated Corrected UART pinouts (par. 3.3.11)	SO
1.3	21st December 2021	Description of Boot Mode selector jumper (CN52) included (par. 3.3.16) RMA page URL updated	SO
1.4	8th April 2022	Commercial name updated CN55 pinout swapped with CN51 (par. 3.3.12)	SB

Every effort has been made to ensure the accuracy of this manual. However, SECO S.p.A. accepts no responsibility for any inaccuracies, errors or omissions herein. SECO S.p.A. reserves the right to change precise specifications without prior notice to supply the best product possible.

For further information on this module or other SECO products, but also to get the required assistance for any and possible issues, please contact us using the dedicated web form available at http://www.seco.com (registration required).

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Chapter 1.
INTRODUCTION

- Warranty
- Information and assistance
- RMA number request
- Safety
- Electrostatic discharges
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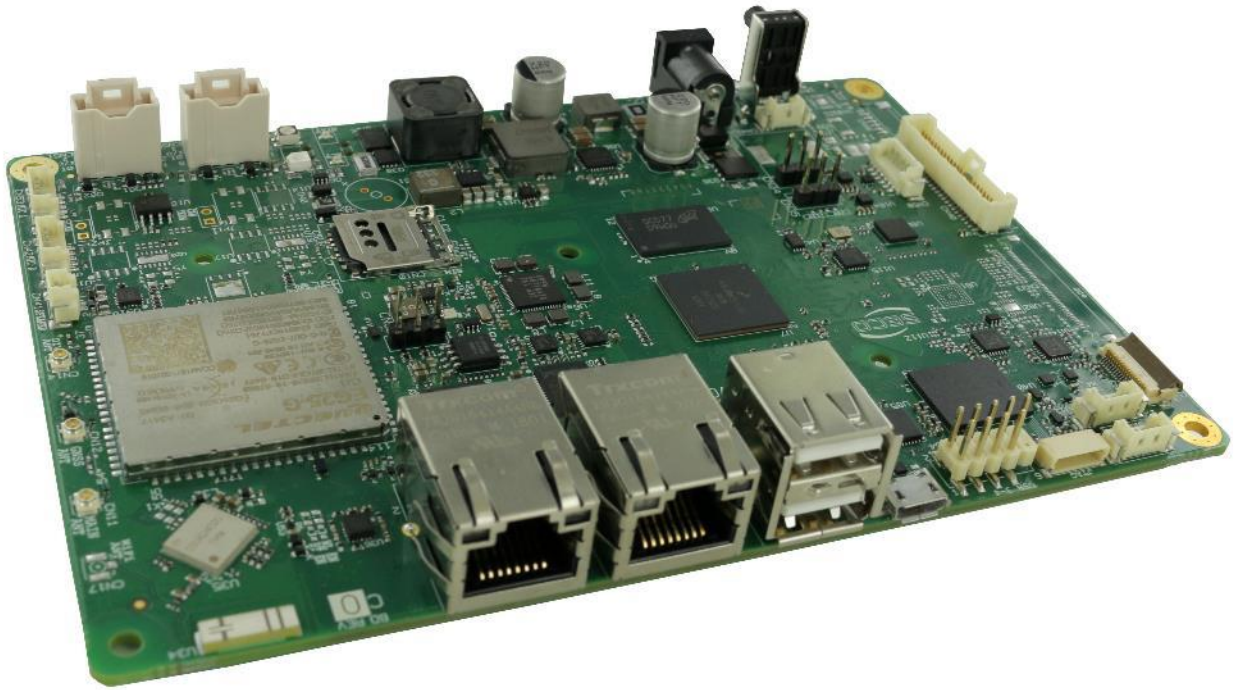
- Safety Policy
- Terminology and definitions
- Reference specifications



1.1 Warranty

This product is subject to the Italian Law Decree 24/2002, acting European Directive 1999/44/CE on matters of sale and warranties to consumers.

The warranty on this product lasts for 1 year.

Under the warranty period, the Supplier guarantees the buyer assistance and service for repairing, replacing or credit of the item, at the Supplier's own discretion.

Shipping costs that apply to non-conforming items or items that need replacement are to be paid by the customer.

Items cannot be returned unless previously authorised by the supplier.

The authorisation is released after completing the specific form available on the web-site https://www.seco.com/us/support/online-rma.html (RMA Online). The RMA authorisation number must be put both on the packaging and on the documents shipped with the items, which must include all the accessories in their original packaging, with no signs of damage to, or tampering with, any returned item.

The error analysis form identifying the fault type must be completed by the customer and has must accompany the returned item.

If any of the above-mentioned requirements for RMA is not satisfied, the item will be shipped back and the customer will have to pay any and all shipping costs.

Following a technical analysis, the supplier will verify if all the requirements, for which a warranty service applies, are met. If the warranty cannot be applied, the Supplier will calculate the minimum cost of this initial analysis on the item and the repair costs. Costs for replaced components will be calculated separately.

Warning!
All changes or modifications to the equipment not explicitly approved by SECO S.p.A. could impair the equipment's functionalities and could void the warranty.

1.2 Information and assistance

What do I have to do if the product is faulty?

SECO S.p.A. offers the following services:

- SECO website: visit http://www.seco.com to receive the latest information on the product. In most cases it is possible to find useful information to solve the problem.
- SECO Sales Representative: the Sales Rep can help to determine the exact cause of the problem and search for the best solution.
- SECO Help-Desk: contact SECO Technical Assistance. A technician is at disposal to understand the exact origin of the problem and suggest the correct solution.

  E-mail: technical.service@seco.com

  Fax (+39) 0575 340434
- Repair centre: it is possible to send the faulty product to the SECO Repair Centre. In this case, follow this procedure:
  - Returned items must be accompanied by a RMA Number. Items sent without the RMA number will be not accepted.
  - Returned items must be shipped in an appropriate package. SECO is not responsible for damages caused by accidental drop, improper usage, or customer neglect.

Note: Please have the following information before asking for technical assistance:

- Name and serial number of the product;
- Description of Customer's peripheral connections;
- Description of Customer's software (operating system, version, application software, etc.);
- A complete description of the problem;
- The exact words of every kind of error message encountered.

1.3 RMA number request

To request a RMA number, please visit SECO's web-site. On the home page, please select "RMA Online" and follow the procedure described.

A RMA Number will be sent within 1 working day (only for on-line RMA requests).

1.4 Safety

The ASTRID board uses only extremely low voltages.

While handling the board, please use extreme caution to avoid any kind of risk or damages to electronic components.

!

Always switch the power off, and unplug the power supply unit, before handling the board and/or connecting cables or other boards.

Avoid using metallic components - like paper clips, screws and similar - near the board when connected to a power supply, to avoid short circuits due to unwanted contacts with other board components.

If the board has become wet, never connect it to any external power supply unit or battery.

Check carefully that all cables are correctly connected and that they are not damaged.

1.5 Electrostatic discharges

The ASTRID board, like any other electronic product, is an electrostatic sensitive device: high voltages caused by static electricity could damage some or all the devices and/or components on-board.

!

Whenever handling a ASTRID board, ground yourself through an anti-static wrist strap. Placement of the board on an anti-static surface is also highly recommended.

1.6 RoHS compliance

The ASTRID board is designed using RoHS compliant components and is manufactured on a lead-free production line. It is therefore fully RoHS compliant.

1.7 Safety Policy

In order to meet the safety requirements of EN62368-1:2014 standard for Audio/Video, information and communication technology equipment, the ASTRID Module shall be:

- used exclusively with limited power sources, which cannot exceed 100W even in fault conditions;
- used along with CPU Heatspreader/heatsinks designed according to the thermal characteristics indicated in the par. 2.2 and to the mechanical characteristics indicated in par. 2.4.
- installed inside an enclosure compliant to all applicable requirements of the above-mentioned standard;
- installed in a way that prevents the access to the board from children

The manufacturer which include a ASTRID module in his end-user product shall:

- verify the compliance with B.2 and B.3 clauses of the EN62368-1 standard when the module works in its own final operating condition.
- provide an instructional safeguard against thermal injuries, according to clause 9.4.2 of the above mentioned standard. This instructional safeguard must be placed both on end-user product's User Manual and on the products itself (Danger Label, it must be placed near the CPU or its heatsink).

The board shall be powered by a Power Supply Unit separately approved and classified ES1/PS2 according to the requirements of IEC EN 62368-1.

1.8 Terminology and definitions

API	Application Program Interface, a set of commands and functions that can be used by programmers for writing software for specific Operating Systems
CAN Bus	Controller Area network, a protocol designed for in-vehicle communication.
DDR	Double Data Rate, a typology of memory devices which transfer data both on the rising and on the falling edge of the clock.
eDP	embedded Display Port, a type of digital video display interface developed especially for internal connections between boards and digital displays.
FFC/FPC	Flexible Flat Cable / Flat Panel Cable
GBE	Gigabit Ethernet
Gbps	Gigabits per second
GND	Ground
GPI/O	General purpose Input/Output
I2C Bus	Inter-Integrated Circuit Bus, a simple serial bus consisting only of data and clock line, with multi-master capability
LPDDR4	Low Power DDR, 4th generation
LVDS	Low Voltage Differential Signaling, a standard for transferring data at very high speed using inexpensive twisted pair copper cables, usually used for video applications
Mbps	Megabits per second
MMC/eMMC	MultiMedia Card / embedded MMC, a type of memory card, having the same interface as the SD card. The eMMC is the embedded version of the MMC. They are devices that incorporate the flash memories on a single BGA chip.
N.A.	Not Applicable
N.C.	Not Connected
OpenCL	Open Computing Language, a software library based on C99 programming language, conceived explicitly to realise parallel computing using Graphics Processing Units (GPU)
OpenVG	Open Vector Graphics, an Open Source API dedicated to hardware accelerated 2D vector graphics
OS	Operating System
OTG	On-the-Go, a specification that allows to USB devices to act indifferently as Host or as a Client, depending on the device connected to the port.
PCI-e	Peripheral Component Interface Express
PHY	Abbreviation of Physical, it is the device implementing the Physical Layer of ISO/OSI-7 model for communication systems
PSU	Power Supply Unit
PWM	Pulse Width Modulation

PWR	Power
RGMII	Reduced Gigabit Reduced Media Independent Interface, a standard interface between the Ethernet Media Access Control (MAC) and the Physical Layer (PHY)
SD	Secure Digital, a memory card type
SDHC	Secure Digital Host Controller
SIM	Subscriber Identity Module, a card which stores all data of the owner necessary to allow him accessing to mobile communication networks
SM Bus	System Management Bus, a subset of the I2C bus dedicated to communication with devices for system management, like a smart battery and other power supply-related devices
SNVS	Secure non-volatile storage
SPI	Serial Peripheral Interface, a 4-Wire synchronous full-duplex serial interface which is composed of a master and one or more slaves, individually enabled through a Chip Select line
TBM	To be measured
UIM	User Identity Module, an extension of SIM modules.
USB	Universal Serial Bus
uSDHC	Ultra Secure Digital Host Controller
V_REF	Voltage reference Pin

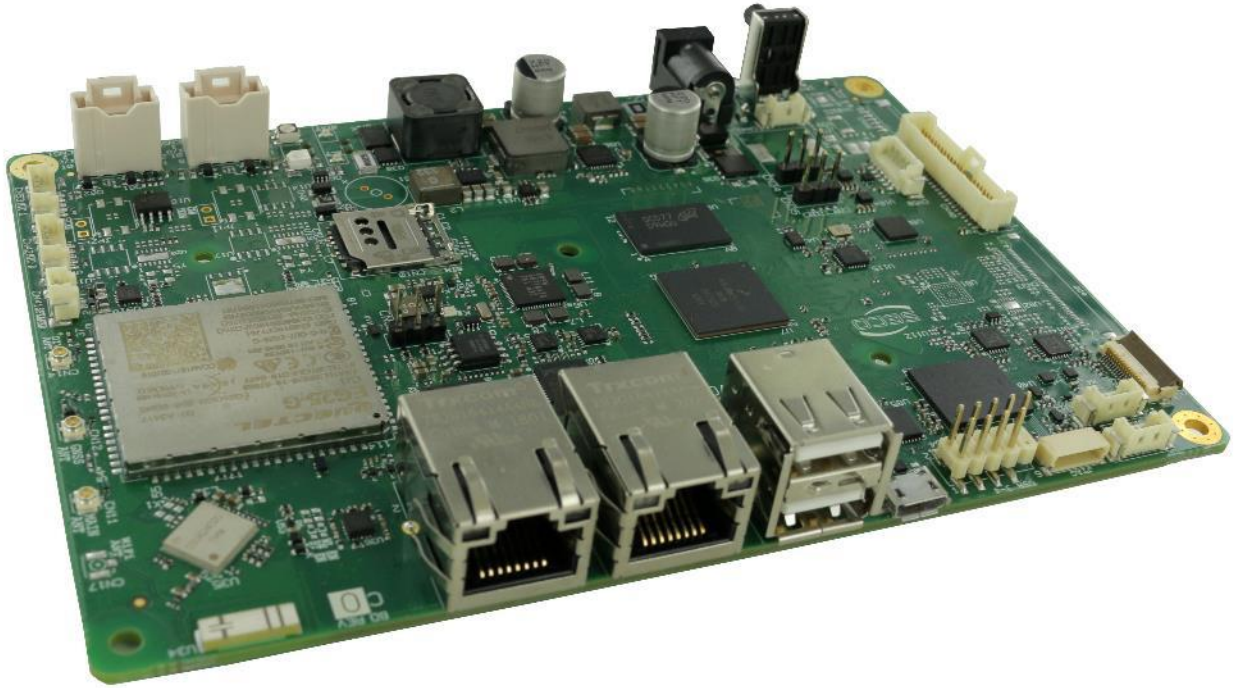
1.9 Reference specifications

Here below it is a list of applicable industry specifications and reference documents.

Reference	Link
CAN Bus	https://www.iso.org/standard/63648.html
eDP	http://www.vesa.org
Gigabit Ethernet	https://www.ieee802.org/3/
I2C	https://www.nxp.com/docs/en/user-guide/UM10204.pdf
I2S	https://www.sparkfun.com/datasheets/BreakoutBoards/I2SBUS.pdf
LVDS	https://www.ti.com/lit/an/snla165/snla165.pdf and https://www.ti.com/lit/ug/snla187/snla187.pdf
MMC/eMMC	https://www.jedec.org/committees/jc-64
NXP i.MX 8M Mini processors	i.MX 8M Mini | Arm Cortex A53 | Cortex M4 | NXP
OpenGL	http://www.opengl.org
OpenVG	http://www.khronos.org/openvg
Quectel EG25 Modem	https://www.quectel.com/UploadFile/Product/Quectel_EG25-G_LTE_Specification_V1.1.pdf
SD Card Association	https://www.sdcard.org/home
SDIO	https://www.sdcard.org/developers/overview/sdio
SM Bus	http://www.smbus.org/specs
USB 2.0 and USB OTG	https://www.usb.org/sites/default/files/usb_20_20190524.zip

Chapter 2.
OVERVIEW

- Introduction
- Technical specifications
- Electrical specifications
- Mechanical specifications
- Block diagram



2.1 Introduction

ASTRID is a Single Board Computer in 3.5” form factor (which is 146 x 102mm) based on embedded NXP i.MX 8M Mini Applications Processors, featuring ARM® Cortex®-A53 processors, Single-, Dual- or Quad- Core + general purpose Cortex®-M4 processor, with frequencies up to 1.8GHz, which are ideal for applications requiring multimedia capabilities.

Graphics features of the board are managed directly by NXP i.MX8M Mini processor, which integrate a GC320 2D Acceleratore and a GCNanoUltra 3D accelerator, supporting OpenGL® ES 2.0 and Open VG 1.1.

HW video decoding of the most common coding standard (i.e., H.265, H.264, VP9, VP8, and others) is supported. Also H.264, VP8 encoding is supported.

The board is completed with up to 4GB LPDDR4-3200 32-bit bus memory directly soldered on board and one eMMC 5.1 Flash Drive with up to 64GB of capacity. Mass storage capabilities are completed by a microSD Card slot.

The board can support 24 bit Single/Dual Channel LVDS interface. As a factory alternative, one eDP interface is available.

The processor offers an RGMII interface which, through a dedicated TI DP83867 Ethernet Transceiver, allows the implementation of a Gigabit Ethernet interface. Another additional GbE interface (optional) is possible using an Intel® I210 Gigabit Ethernet controller, managed through the processor’s PCI-e interface.

The networking capabilities of this module are extended by an optional WiFi 802.11 a/b/g/n/ac + BT 5.0 NGFF module soldered on-board.

An LTE Cat4 module, Quectel EG-25, with dedicated micro-SIM slot is also available as a factory option

The ASTRID board offers two USB 2.0 standard Type-A connectors, an internal header with two additional USB 2.0 Host ports and an USB 2.0 port on micro-AB connector (this interface is shared with the optional modem).

The audio functionalities of this board are represented by an amplified mono Speaker connector + 2 x PDM digital Mic In connectors.

Three internal connectors complete the functionalities of this board. On these connectors, managed as factory options, it is possible to found up to 2x RS-232 or RS-485 or CAN ports, GPIOS, SPI interface

The board is available both in commercial and in industrial temperature range.

Please refer to following chapter for a complete list of all peripherals integrated and characteristics.

2.2 Technical specifications

Processors

NXP i.MX 8M Mini Family based on ARM® Cortex®-A53 cores + general purpose Cortex®-M4 400MHz processor:

- i.MX 8M Mini Quad - Full featured, 4x Cortex®-A53 cores, up to 1.8GHz
- i.MX 8M Mini Dual - Full featured, 2x Cortex®-A53 cores, up to 1.8GHz
- i.MX 8M Mini Solo - Full featured, 1x Cortex®-A53 cores, up to 1.8GHz
- i.MX 8M Mini Quad Lite - 4x Cortex®-A53 cores, up to 1.8GHz, no VPU
- i.MX 8M Mini Dual Lite - 2x Cortex®-A53 cores, up to1.8GHz, no VPU
- i.MX 8M Mini Solo Lite - 1x Cortex®-A53 cores, up to 1.8GHz, no VPU

Memory

Soldered Down LPDDR4 memory, 32-bit interface, up to 4GB

Graphics

Vivante GC320 2D accelerator + GCNanoUltra 3D accelerator
OpenGL ES 2.0, OpenVG 1.1 support
Embedded VPU (not for Lite processors), supporting:

- HW Decoding of VP9, HEVC/H.265, AVC/H.264, VP8
- HW Encoding of AVC/H.264, VP8

Video Interfaces

LVDS Single/Dual Channel connector or eDP connector (factory alternatives)
MIPI-CSI camera connector

Video Resolution

Up to 1920x1080p @ 60Hz

Mass Storage

Optional eMMC 5.1 Drive soldered on-board, up to 64GB
microSD slot on board
Optional QuadSPI Flash soldered-onboard
2Kb I2C Flash

Networking

Up to 2x Gigabit Ethernet interface
Optional Shielded Ultra Small Dual Band WiFi 802.11 a/b/g/n/ac with Bluetooth 5.0 Module onboard
Optional soldered on-board LTE Cat 4 Modem with micro-SIM slot or Telenor eSIM with 5MB Bundle

USB

2 x USB 2.0 Host ports on Type-A sockets
2 x USB 2.0 Host ports on internal header
1 x USB Host or Client Port on micro-AB connector (interface shared with optional LTE Modem)

Audio

Digital Mic In connector (2x PDM inputs)
Amplified mono Speaker Output

Serial ports

Up to 2x RS-232 or RS-485or CAN ports (factory alternatives, also alternatives to GPIOs and SPI interfaces
2x Debug UARTs

Other Interfaces

I/O Connectors with:

- 2xPWM @3.3V
- GP I2C interface @3.3V
- 1x Open Drain output (max 12V, 250mA)
- 2x GPIOs @3.3V
- 1x RS-232 or 1x RS-485 or 4x GPIOs / 1x UART or 1x CAN (factory options)
- 1x RS-232 or 1x RS-485 or 4x GPIOs / 1x UART or 1x CAN + on-board ultra-low power RTC (factory options)

Watchdog
Dedicated connector for I2C Touch Screen Controller Support
Onboard Buzzer (commercial temp. range board only)
Optional Trust Secure Element

Power supply voltage: +12V_{DC} .. +24V_{DC}

Operating temperature:

Commercial version 0°C ÷ +60°C **.
Industrial version: -40°C ÷ +85°C ** (limited to -30°C ÷ +85°C with WiFi/BT module on-board)

Dimensions: 72 x 100 mm (2.83" x 3.93")

Supported Operating Systems: Yocto

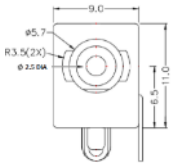
Android (planned)

! *** Measured at any point of SECO standard heatsink for this product, during any and all times (including start-up). Actual temperature will widely depend on application, enclosure and/or environment. Upon customer to consider application-specific cooling solutions for the final system to keep the heatspreader temperature in the range indicated. Please also check paragraph 4.1*

2.3 Electrical specifications

ASTRID board can be supplied with any voltage in the range +12V_{DC} ÷ +24V_{DC} range (recommended voltage range)

This voltage can be supplied through a standard 5.7mm (internal pin, diameter 2.5mm) Power Jack (CN1). Internal pin is V_{IN} power line.



Power IN PCB terminal block - CN2	
Pin	**Signal**
1	V_{IN}
2	GND

As an alternative, the board can be equipped with a 2-pin PCB Terminal Block with front spring-cage connection type PHOENIX CONTACT p/n 1990973 or equivalent, which can be used for the connection of an external PSU.

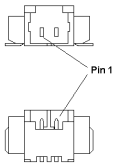
2.3.1 RTC Battery

For the occurrences when the module is not powered with an external power supply, on board there is a cabled coin Lithium Battery to supply, with a 3V voltage, the Real Time Clock present on-board (factory option, see par 3.3.12)

Battery used is a cabled CR2032-LD Lithium coin-cell battery, with a nominal capacity of 220mAh.

Cabled Coin Cell Battery Connector – CN43	
Pin	**Signal**
1	3V_BAT
2	GND

The battery is not rechargeable, and can be connected to the board using dedicated connector CN43 which is a 2-pin p1.27 mm type MOLEX p/n 53261-0271 or equivalent, with pinout shown in the table on the left.



Mating connector: MOLEX 51021-0200 receptacle with MOLEX 50079-8000 female crimp terminals.

In case of exhaustion, the battery should only be replaced with devices of the same type. Always check the orientation before inserting and make sure that they are aligned correctly and are not damaged or leaking.

Never allow the batteries to become short-circuited during handling.

! CAUTION: handling batteries incorrectly or replacing with not-approved devices may present a risk of fire or explosion.

Batteries supplied with ASTRID board are compliant to requirements of European Directive 2006/66/EC regarding batteries and accumulators. When putting out of order ASTRID, remove the batteries from the board in order to collect and dispose them according to the requirement of the same European Directive above mentioned. Even when replacing the batteries, the disposal has to be made according to these requirements.

2.3.2 Power rails

In all the tables contained in this manual, the power rails are named with the following meaning:

V_{IN}: Power In voltage (in the range $+12V_{DC}$ ..$+24V_{DC}$) directly coming from the Power Supply connectors CN1 or CN2

3V_BAT: 3V power rail for supplying the optional Ultra Low Power RTC

+5V_A: +5V power rail, directly generated from VIN power rail, immediately available when VIN voltage is applied.

+3V3_A: +3.3V power rail, directly generated from VIN power rail, immediately available when VIN voltage is applied and 5V_A voltage is stable.

VDD_3V3: main +3.3V power rail generated by the on-board PMIC powered by 5V_A power rail.

VDD_1V8: main +1.8V power rail generated by the on-board PMIC powered by 5V_A power rail.

+3.3V_AUX: Auxiliary 3.3V Power rail, derived from +3.3V_A rail when VDD_3V3 power rail is stable.

+3V3_OUT: 3.3V power rail specific for I/O connectors, derived from +3.3V_A power rail upon SW enabling.

NVCC_SNVS_1V8: +1.8V power rail for GPIO Pre-driver in SNVS (secure non-volatile storage) bank, generated by the on-board PMIC.

2.3.3 Power consumption

The power consumption has been measured on V_{IN} power rail using a $19V_{DC}$ source. For measurement, two different configurations has been considered.

Configuration #1

Processor i.MX8M Mini Quad Full Featured;
RAM: 4GB LPDDR4;
Storage: 64GB eMMC;
Video Interface: LVDS + LED Driver;
Networking: 2x Gigabit LAN + Modem with SIM Slot + WiFi with PCB Antenna;
Expansion interfaces: 2x CAN
Other: Audio Codec, Trusted Secure Element
Industrial Temperature range

21.5” LVDS display type AUO P215HVN01.0 connected

Configuration #2

Processor i.MX8M Mini SoloLite;
RAM: 1GB LPDDR4;
Storage: 4GB eMMC;
Video Interface: eDP;
Networking: 2x Gigabit LAN + WiFi with u.FL Connector;

Expansion interfaces: 2x RS-485 ports
Other: Audio Codec, Trusted Secure Element
Industrial Temperature range

15.6” eDP display type BOE EV156FHM-N10 connected

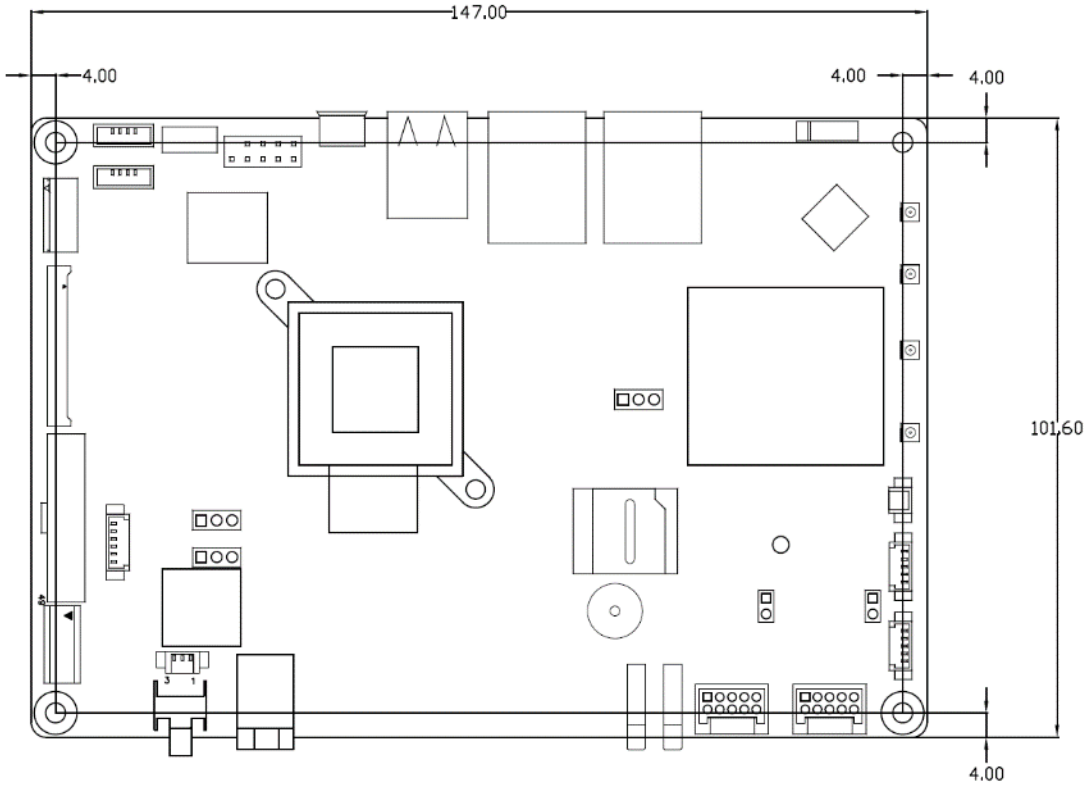
Status	Configuration #1				Configuration #2			
	Average Value (30s)		Peak Value		Average Value (30s)		Peak Value	
Idle	3.52W	0.185A	3.7W	0.196A	3.5W	0.185A	3.9W	0.207A
Idle optimized (*)	2.07W	0.109A	2.13W	0.112A	---	---	---	---
OS Boot	15.39W	0.81A	21.7W	1.41A	8.59W	0.452A	19.57W	1.03A
Video reproduction 1080p	3.7W	0.196A	3.84W	0.202A	---	---	---	---
CPU 100% + GPU 100% + Video Reproduction FullHD	5.6W	0.297A	5.7W	0.3A	4.7W	0.248A	5.40W	0.284°

(*) Idle optimized: Modem not powered, WiFi/BT disabled, Eth0 disabled, video disabled

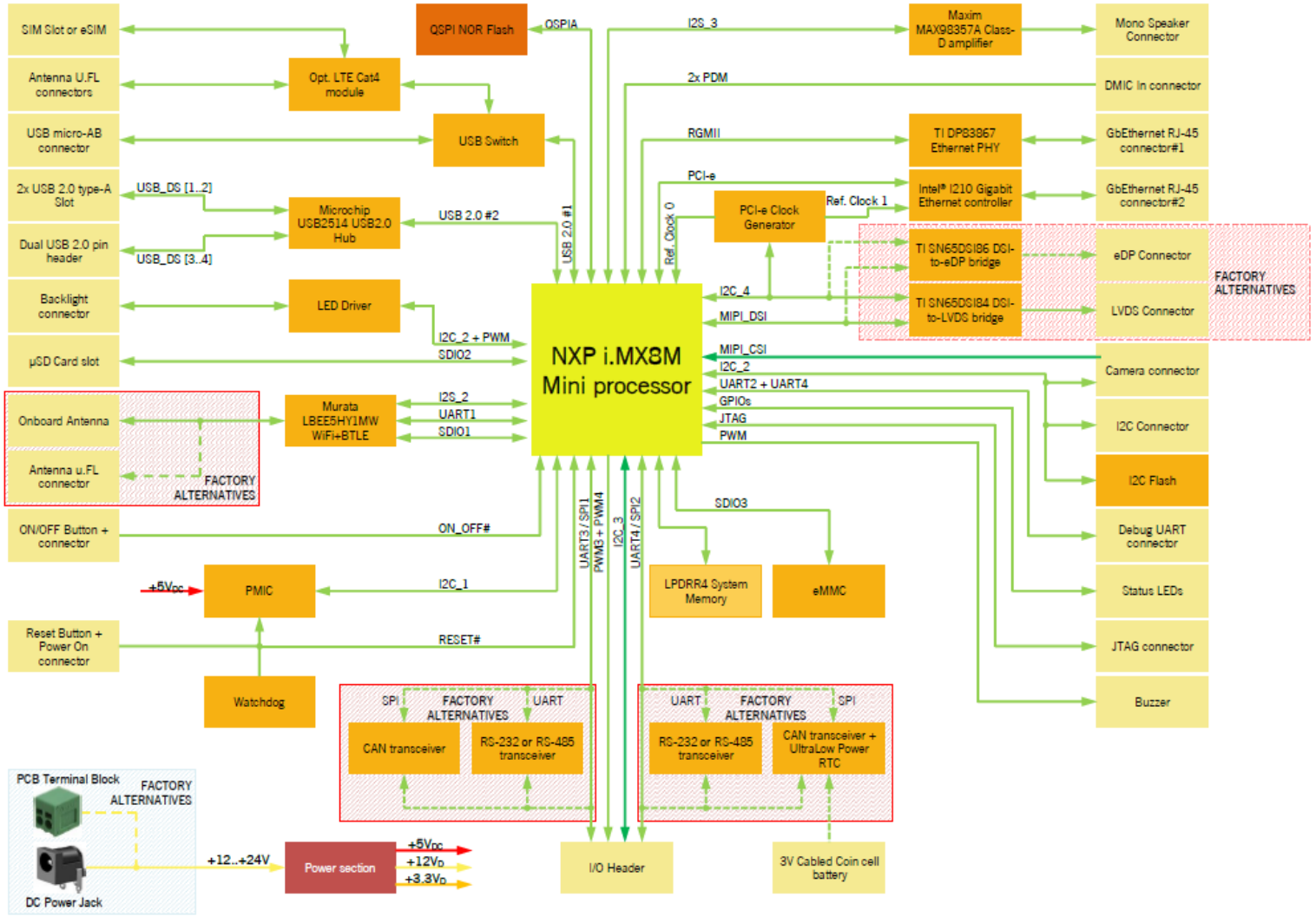
2.4 Mechanical specifications

According to 3.5” form factor, board dimensions are: 146 x 101.6 mm (5.75” x 4.02”).

The printed circuit of the board is made of ten layers, some of them are ground planes, for disturbance rejection.

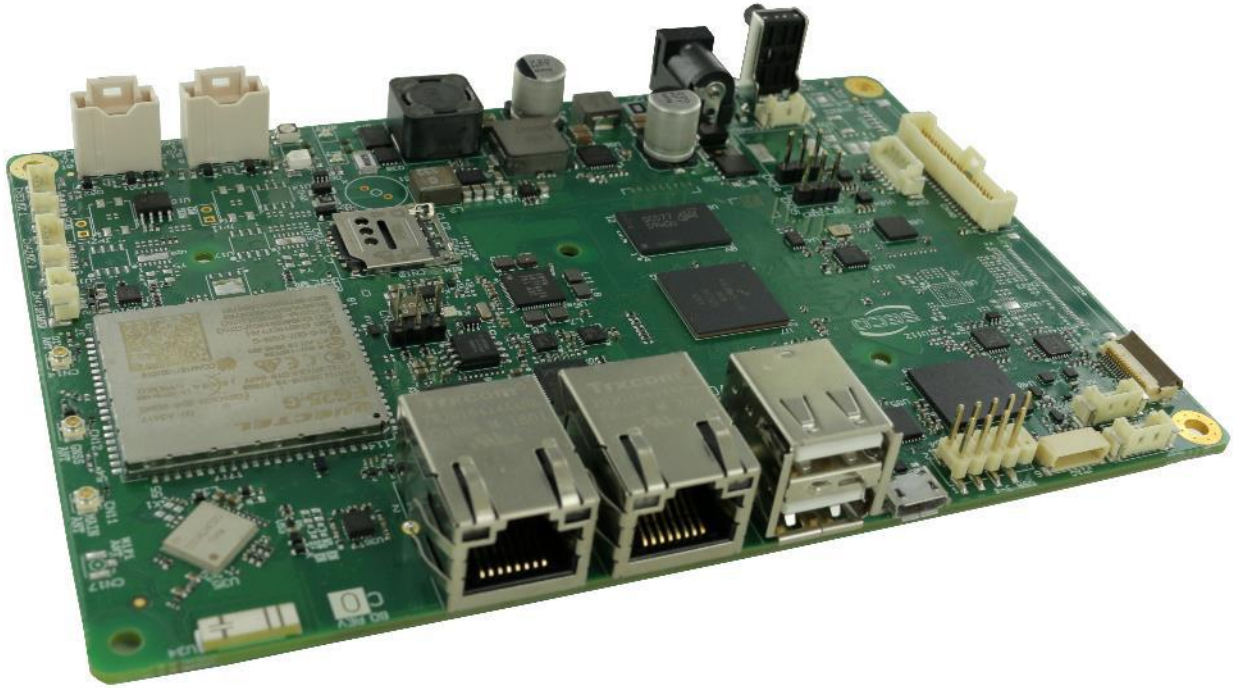


2.5 Block diagram



Chapter 3.
CONNECTORS

- Introduction
- Connectors overview
- Connectors description

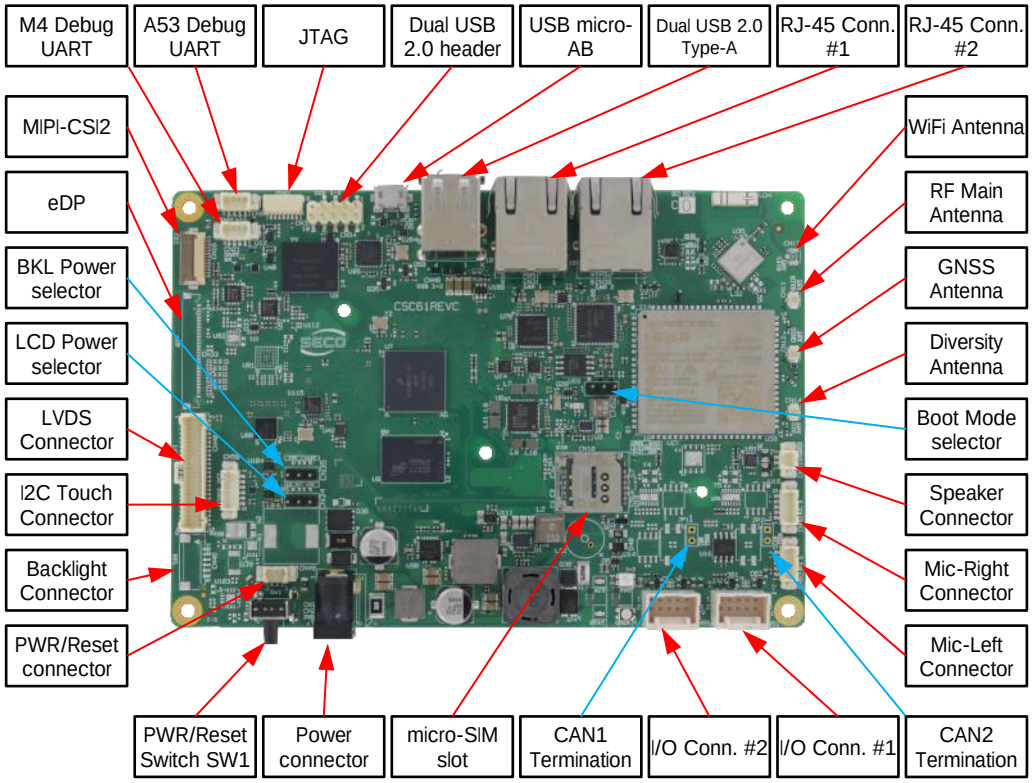


3.1 Introduction

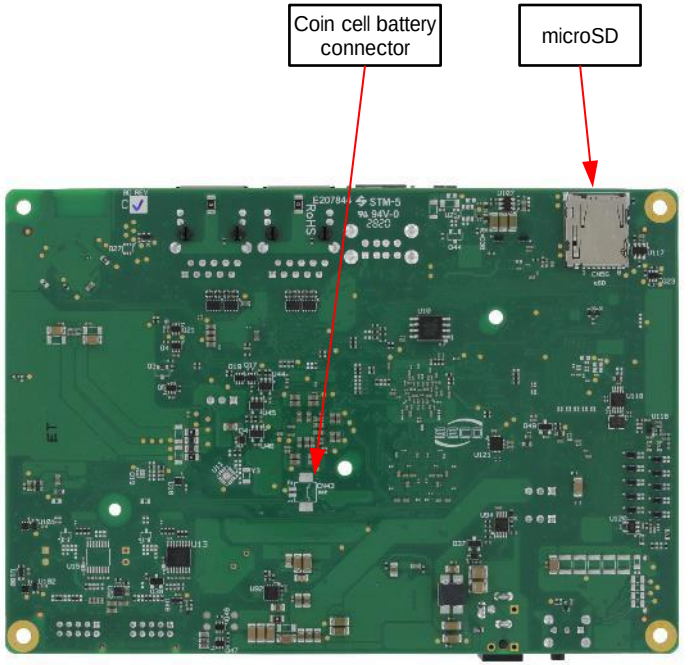
On ASTRID board, there are several connectors located on the lower plane. Standard connectors are placed on the same side of PCB, so that it is possible to place them on a panel of an eventual enclosure.

> **!** Please be aware that, depending on the configuration purchased, the appearance of the board could be different from the following pictures.

TOP SIDE



BOTTOM SIDE



3.2 Connectors overview

3.2.1 Connector List

Name	Description	Name	Description
CN1	Power In Connector	CN38	GbEthernet RJ-45 Connector #2
CN2	Power IN PCB terminal block	CN40	LVDS Connector
CN3	JTAG Connector	CN41	Mono Speaker Connector
CN6	A53 Debug UART Connector	CN42	MIC Connector right channel
CN10	SIM slot	CN43	Cabled Coin Cell Battery Connector
CN11	RF Antenna Connector	CN46	Backlight Connector
CN12	GNSS Antenna Connector	CN48	Dual USB 2.0 Type-A Socket
CN14	Div Antenna Connector	CN49	ON/OFF and Reset Connector
CN16	MIPI-CSI2 Connector	CN50	I2C Touch Connector
CN17	WiFi Antenna Connector	CN51	I/O Connector #1
CN21	M4 Debug UART Connector	CN53	MIC Connector left channel
CN31	GbEthernet RJ-45 Connector #1	CN54	Dual USB 2.0 pin Header
CN33	eDP connector	CN55	I/O Connector #2
CN36	USB micro-AB Connector	CN56	microSD card Slot

3.2.2 Jumpers List

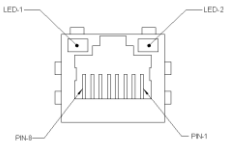
Name	Description	Name	Description
CN34	LCD Power selector	JP1	CAN1 Bus Termination
CN35	Backlight Power selector	JP2	CAN2 Bus Termination
CN52	Boot Mode selector		

3.3 Connectors description

3.3.1 Gigabit Ethernet connectors

Gigabit Ethernet Port #1 – CN31			
Pin	**Signal**	**Pin**	**Signal**
1	GBE1_MDI0+	5	GBE1_MDI2-
2	GBE1_MDI0-	6	GBE1_MDI1-
3	GBE1_MDI1+	7	GBE1_MDI3+
4	GBE1_MDI2+	8	GBE1_MDI3-

Optional Gigabit Ethernet Port #2 – CN38			
Pin	**Signal**	**Pin**	**Signal**
1	GBE2_MDI0+	5	GBE2_MDI2-
2	GBE2_MDI0-	6	GBE2_MDI1-
3	GBE2_MDI1+	7	GBE2_MDI3+
4	GBE2_MDI2+	8	GBE2_MDI3-



On board, there are up to two Gigabit Ethernet connector, for the direct connection of the ASTRID to two different wired LANs.

The first Ethernet connection is realised by using Texas Instrument DP83867CRRGZR 10Base-T/100Base-Tx/1000Base-Tx Ethernet PHY Transceiver interfaced to NXP processor's eNET interface.

The second Ethernet connection is realised by using Intel® I210 family Gigabit Ethernet controller interfaced to NXP processor's PCI-e interface.

First connection is available on connector CN31, and it is always available. The second connection, available on RJ-45 connector CN38, instead, is available only as a factory option.

The connectors are type TRXCOM p/n TRJG16314A4NL or equivalent, with 2kV decoupling capacitor, 100 Ohm impedance.

These interfaces are compatible both with Gigabit Ethernet (1000Mbps) and with Fast Ethernet (10/100Mbps) Networks. They will configure automatically to work with the existing network.

Please be aware that it will work in Gigabit mode only in case that it is connected to Gigabit Ethernet switches/hubs/routers. For the connection, cables category Cat5e or better are required. Cables category Cat6 are recommended for noise reduction and EMC compatibility issues, especially when the length of the cable is significant.

On the connectors there are also two bicolor (Green /Yellow) LEDs for each port. Left LED shows 10/100 or 1000 connection: green means 100Mbps connection, yellow means 1000Mpbs connection, when the LED is Off then 10Mpbs or no connection is available. The right LED blinks Green to show ACTIVITY presence.

GBEx_MDI0+/GBEx_MDI0-: Ethernet Controller #x Media Dependent Interface (MDI) I/O differential pair #0. It is the first differential pair in Gigabit Ethernet mode, and the Transmit differential pair in 10/100 Mbps modes.

GBEx_MDI1+/GBEx_MDI1-: Ethernet Controller #x Media Dependent Interface (MDI) I/O differential pair #1. It is the second differential pair in Gigabit Ethernet mode, and the Receive differential pair in 10/100 Mbps modes.

GBEx_MDI2+/GBEx_MDI2-: Ethernet Controller #x Media Dependent Interface (MDI) I/O differential pair #2. It is the third differential pair in Gigabit Ethernet mode; it is not used in 10/100Mbps modes.

GBEx_MDI3+/GBEx_MDI3-: Ethernet Controller #x Media Dependent Interface (MDI) I/O differential pair #3. It is the fourth differential pair in Gigabit Ethernet mode; it is not used in 10/100Mbps modes.

3.3.2 On board optional modem

The ASTRID board can be equipped with one embedded LTE Cat 4 modem module (optional), type QUECTEL EG25-G.

This optional Modem module supports:

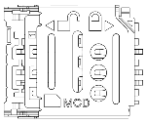
- LTE-FDD (with receive diversity) B1 / B2 / B3 / B4 / B5 / B7 / B8 / B12 / B13 / B18 / B19 / B20 / B25 / B26 / B28
- LTE-TDD (with receive diversity) B38 / B39 / B40 / B41
- UMTS (with receive diversity) B1 / B2 / B4 / B5 / B6 / B8 / B19
- GSM 850 / 900 / 1800 / 1900MHz
- GNSS Functionality GPS, GLONASS, Beidou/Compass, Galileo, QZSS

When the modem module is mounted, on-board there are also three U/FL connectors (type HIROSE U.FL-R-SMT1(10))for external antennas, more specifically:

- U.FL connector CN11 for RF Antenna
- U.FL connector CN12 for GNSS Antenna (the module is ready for the connection of active antennas, voltage managed by PMIC's LDO5_VOUT).
- U.FL connector CN14 for Diversity Antenna

micro-SIM Card Slot – CN10			
Pin	Signal	Pin	Signal
1	USIM_PWR	5	GND
2	USIM_RST#	6	---
3	USIM_CLK	7	USIM_DATA
4	---	8	---

As a further option, the modem can be paired to the micro-SIM slot CN10 or to the eSIM onboard. Boards equipped with the micro-SIM slot offer a socket type MOLEX. p/n 78800-0001or equivalent, with the pinout shown in the table on the left.



Here it is possible to insert the micro-SIM card provided by any telecommunication operator for the connection to their network.

UIM_RST#: Reset signal line, sent from EG25-G module to the micro-SIM module.

UIM_DATA: Bidirectional Data line between EG25-G module and the micro-SIM module.

UIM_CLK: Clock line, output from M EG25-G module to the micro-SIM module.

UIM_PWR: Power line for the micro-SIM module. Can be 1.8V or 3.3V, it is supported by the EG25-G module automatically.

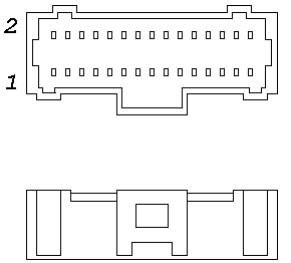
3.3.3 On board WiFi + BT modules

The ASTRID board can be equipped with a Dual band (2.4GHz + 5.0 GHz) WLAN 802.11 a/b/g/n/ac + BT 5.0 embedded module, which is Murata Type 1MW, p/n LBEE5HY1MW-230.

This optional WiFi + BT module, as a further factory option, can be equipped with a PCB ceramic chip antenna (PulseLarsen W3006) or with an U.FL connector (CN17, type HIROSE U.FL-R-SMT1(10))for external antenna.

3.3.4 LVDS connector

LVDS connector – CN40			
Pin	**Signal**	**Pin**	**Signal**
1	LCD_PWR	2	BKLT_PWR
3	LCD_PWR	4	BKLT_PWR
5	LCD_PWR	6	BKLT_PWR
7	+3.3V_RUN	8	GND
9	GND	10	LVDS_0_TX0+
11	LVDS_0_TX1+	12	LVDS_0_TX0-
13	LVDS_0_TX1-	14	GND
15	GND	16	LVDS_0_TX2+
17	LVDS_0_TX3+	18	LVDS_0_TX2-
19	LVDS_0_TX3-	20	GND
21	GND	22	LVDS_0_CLK+
23	LVDS_1_TX0+	24	LVDS_0_CLK-
25	LVDS_1_TX0-	26	GND
27	GND	28	LVDS_1_TX1+
29	LVDS_1_TX2+	30	LVDS_1_TX1-
31	LVDS_1_TX2-	32	GND
33	GND	34	LVDS_1_TX3+
35	LVDS_1_CLK+	36	LVDS_1_TX3-
37	LVDS_1_CLK-	38	GND
39	GND	40	GND
41	BKLT_EN	42	BKLT_PWM
43	BKLT_AN_CTRL	44	PVCC_EN
45	TOUCH_SCL	46	TOUCH_RST
47	TOUCH_SDA	48	TOUCH_INT#
49	GND	50	GND



ASTRID board can be interfaced to LCD displays using its LVDS interface, which allows connecting 18 or 24 bit, single or dual channel displays. This interface is implemented using a DSI to LVDS bridge (TI SN65DSI84), which allow the implementation of a Dual Channel LVDS, with a maximum supported resolution of 1920x1080 @ 60Hz (dual channel mode). Such an interface is derived from Processor's MIPI-DSI Interface .

For the connection, a connector type HR A1014WA-S-2x25P or equivalent (2 x 25p, male, straight, P1, low profile, polarised) is provided.

Mating connector: HR A1014H-2X25P with HR A1014-T female crimp terminals.

Alternative mating connector, MOLEX 501189-5010 with crimp terminals series 501334.

On the same connector are also implemented the signals for direct driving of display's backlight: voltages (LCD_PWR and BKLT_PWR) and control signals (LCD enable signal, PVCC_EN, Backlight enable signal, BKLT_EN, and Backlight Brightness Control signal with pulse width modulation and analog control, BKLT_PWM, BKLT_AN_CTRL).

There are also the signals necessary for driving I2C touchscreens (I2C signals, reset and interrupt request signals).

When building a cable for connection of LVDS displays, please take care of twist as tight as possible differential pairs' signal wires, in order to reduce EMI interferences. Shielded cables are also recommended.

Here following the signals related to LVDS management:

LVDS_0_TX0+/ LVDS_0_TX0-: LVDS Channel #0 differential data pair #0.

LVDS_0_TX1+/ LVDS_0_TX1-: LVDS Channel #0 differential data pair #1.

LVDS_0_TX2+/ LVDS_0_TX2-: LVDS Channel #0 differential data pair #2.

LVDS_0_TX3+/ LVDS_0_TX3-: LVDS Channel #0 differential data pair #3.

LVDS_0_CLK+/LVDS_0_CLK-: LVDS Channel #0 differential Clock.

LVDS_1_TX0+/ LVDS_1_TX0-: LVDS Channel #1 differential data pair #0.

LVDS_1_TX1+/ LVDS_1_TX1-: LVDS Channel #1 differential data pair #1.

LVDS_1_TX2+/ LVDS_1_TX2-: LVDS Channel #1 differential data pair #2.

LVDS_1_TX3+/ LVDS_1_TX3-: LVDS Channel #1 differential data pair #3.

LVDS_1_CLK+/LVDS_1_CLK-: LVDS Channel #1 differential Clock.

BKLT_EN: LCD_PWR electrical level Output with a 10kΩ pull-up resistor, Backlight Enable signal. It can be used to turn On/Off the backlight's lamps of connected displays.

PVCC_EN: LCD_PWR electrical level Output with a 10kΩ pull-up resistor, Panel Power Enable signal. It can be used to turn On/Off the connected display.

BKLT_PWM: this signal can be used to adjust the backlight brightness in displays supporting Pulse Width Modulated (PWM) regulations (LCD_PWR electrical level).

BKLT_AN_CTRL: Analog dimming for backlight, electrical level ranging from 0V up to LCD_PWR

TOUCH_SCL: I2C Bus clock line. Bidirectional signal, electrical level VDD_3V3 with a 2K2Ω pull-up resistor. It is managed by the processor's I2C controller #3.

TOUCH_SDA: I2C Bus data line. Bidirectional signal, electrical level VDD_3V3 with a 2K2Ω pull-up resistor. It is managed by the processor's I2C controller #3.

TOUCH_RST: VDD_3V3 electrical level output, active high signal with a 10kΩ pull-down resistor. This signal can be used to drive a reset of an eventual external Touch Screen connected to the dedicated I2C interface.

TOUCH_INT#: VDD_3V3 electrical level input with a 10kΩ pull-up resistor. This signal can be used to serve the interrupt request of an eventual external Touch Screen connected to the dedicated I2C interface.

CN34 position	LCD Power selection
1-2	+3.3V
2-3	+5V

LCD_PWR: LCD switched voltage rail. Its value can be set to +3.3V or +5V by using dedicated jumper CN34, which is a standard pin header, P2.54mm, 1x3 pin.

CN35 position	Backlight Power selection
1-2	+5V
2-3	+12V

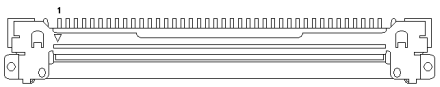
BKLT_PWR: Backlight switched voltage rail. Its value can be set to +5V or +12V by using dedicated jumper CN35, same type of CN34. This jumper is not available on boards equipped with the optinal LED Driver (see par. 3.3.6)

Since the use of jumpers in environments with vibrations issues could be a problem, it is possible to provide ASTRID boards with the LCD Power and Backlight Power fixed at the desired value. For this purpose, some dedicated 0-Ohm resistors can be mounted (factory default: not available). Please contact you local Sales rep in case you need this special configuration.

3.3.5 eDP Connector

eDP connector - CN33			
Pin	**Signal**	**Pin**	**Signal**
1	---	21	LCD_PWR
2	BKLT_PWR	22	LCD_PWR
3	BKLT_PWR	23	LCD_PWR
4	BKLT_PWR	24	GND
5	BKLT_PWR	25	eDP_AUX_N
6	---	26	eDP_AUX_P
7	---	27	GND
8	BKLT_PWM	28	eDP_ML0P
9	BKLT_EN	29	eDP_ML0N
10	GND	30	GND
11	GND	31	eDP_ML1P
12	GND	32	eDP_ML1N
13	GND	33	GND
14	---	34	eDP_ML2P
15	GND	35	eDP_ML2N
16	GND	36	GND
17	GND	37	eDP_ML3P
18	GND	38	eDP_ML3N
19	---	39	GND
20	LCD_PWR	40	---

ASTRID board offers, as a factory alternative to LVDS interface, a dedicated embedded Display Port interface, which is obtained by using a DSI-to-eDP bridge type TI SN65DSI86. Maximum supported resolution is 1920x1080 @ 60Hz.



For the connection of this kind of displays, on-board there is a VESA® certified connectors for embedded Display Port interface, type STARCONN p/n 300E40-0110RA-G3 or equivalent (microcoaxial cable connector, 0.5mm pitch, 40 positions).

BKLT_PWR and LCD_PWR values can be set by using dedicated jumpers CN34 and CN35, as described in the previous paragraph 3.3.4.

Here following the signals involved in eDP management:

eDP_ML0P/eDP_ML0N: embedded DP differential data pair #0.

eDP_ML3P/eDP_ML1N: embedded DP differential data pair #1.

eDP_ML3P/eDP_ML2N: embedded DP differential data pair #2.

eDP_ML3P/eDP_ML3N: embedded DP differential data pair #3.

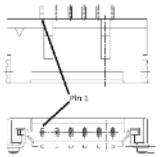
eDP_AUX_P/eDP_AUX_N: embedded DP auxiliary channel differential data pair.

BKLT_EN: LCD_PWR electrical level Output with a 10kΩ pull-up resistor, Backlight Enable signal. It can be used to turn On/Off the backlight's lamps of connected displays.

BKLT_PWM: this signal can be used to adjust the backlight brightness in displays supporting Pulse Width Modulated (PWM) regulations (LCD_PWR electrical level).

3.3.6 Optional LED Driver Connector

Backlight connector – CN46	
Pin	Signal
1	V_LED+
2	V_LED+
3	V_LED1-
4	V_LED2-
5	V_LED3-
6	V_LED4-



ASTRID board also allow the connection of LVDS Displays requiring a dedicated LED Driver.

The functionality is implemented using an optional 4-Channel WLED controller type MPS MP3385GR-Z driven by I2C interface #2 of iMX8M Mini processor.

Through this connector, it is possible to connect up to 4 LED strings requiring a max of 68mA per string (60V max voltage).

The connector is a 4-pin 1.25mm pitch connector, type HR P/N A1253WR-SF-06P, with the pinout indicated in the table on the left.

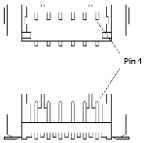
Mating connector: HR P/N A1253H-06P with female crimp contacts type HR P/N A1253-TPE or A1253-GPE

V_LED+: Strings' common LED Anode output

V_LEDx-: LED String x Cathode Input

3.3.7 I2C Touch Screen Connector

I2C Touch connector – CN50	
Pin	Signal
1	VDD_3V3
2	TOUCH_INT#
3	TOUCH_SDA
4	TOUCH_SCL
5	TOUCH_RST
6	GND



It is possible to connect an external Touch Screen also using the dedicated connector CN50, whose pinout is described in the table on the left, instead of using the signals available on LVDS Connector.

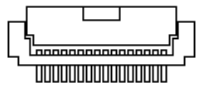
This connector is a 1.25mm pitch connector type Molex p/n 53398-0671 or equivalent.

Mating connector: MOLEX 51021-0500 receptacle with MOLEX 50079-8000 female crimp terminals.

The signals available on this connector are exactly the same available on LVDS connector CN40. Please look at par. 3.3.4. for their description.

3.3.8 MIPI-CSI2 Connector

MIPI-CSI2 connector– CN16			
Pin	Signal	Pin	Signal
1	MIPI_CSI_D3_N	10	MIPI_CSI_D0_N
2	MIPI_CSI_D3_P	11	MIPI_CSI_D0_P
3	MIPI_CSI_D2_N	12	GND
4	MIPI_CSI_D2_P	13	CAM0_ENA#
5	MIPI_CSI_D1_N	14	N.C.
6	MIPI_CSI_D1_P	15	I2C_CAM0_SCL
7	MIPI_CSI_CLK_N	16	I2C_CAM0_SDA
8	MIPI_CSI_CLK_P	17	CAM0_RST#
9	GND	18	+3.3V_AUX



NXP iMX8M Mini Processor includes an Image Processing Subsystem, that can be used for video applications, like video-preview, video recording and frame grabbing.

It is possible to access to the video input port through an FFC/FPC connector, type HIROSE p/n FH12-18S-0.5SH(55) which is able to accept 18 poles 0.5mm pitch FFC cables.

CAM0_ENA#: Camera enable output, active low signal, electrical level VDD_1V8

CAM0_RST#: Camera Reset output, active low signal, electrical level VDD_1V8

I2C_CAM0_SCL: I2C Bus clock line. Bidirectional signal, electrical level VDD_1V8 with a 2K2Ω pull-up resistor. It is managed by the processor's I2C controller #2.

I2C_CAM0_SDA: I2C Bus data line. Bidirectional signal, electrical level VDD_1V8 with a 2K2Ω pull-up resistor. It is managed by the processor's I2C controller #2.

MIPI_CSI_D0_P/ MIPI_CSI_D0_N: MIPI CSI Port differential data pair #0.

MIPI_CSI_D1_P/ MIPI_CSI_D1_N: MIPI CSI Port differential data pair #1.

MIPI_CSI_D2_P/ MIPI_CSI_D2_N: MIPI CSI Port differential data pair #2.

MIPI_CSI_D3_P/ MIPI_CSI_D3_N: MIPI CSI Port differential data pair #3.

MIPI_CSI_CLK_P/ MIPI_CSI_CLK_N: MIPI CSI Port differential clock pair.

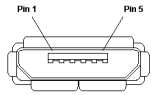
When connecting CSI cameras to CN16 connector, it is strongly recommended to use shielded cable for EMC compatibility.

3.3.9 USB Connectors

The i.MX8M Mini processor offers a total amount of two USB 2.0 OTG interfaces

USB micro-AB Connector – CN36	
Pin	**Signal**
1	+5V_USB_OTG
2	USB_OTG1-
3	USB_OTG1+
4	USB_ID
5	GND

The first USB OTG interface is carried out to a standard micro-AB connector, described in the table on the left, type ZX62-B-5PA.



Depending on the needed use of the system, it is necessary to connect micro-A or micro-B USB cables to connector CN36.

A micro-A USB cable has to be used when the system has to work in Host mode. In this case, USB_VBUS is a power output of ASTRID Board for the connected device.

When a micro-B USB cable is used, its USB_ID pin is floating; this way, the board acknowledges that it must configure itself to work as a Client. In this case, USB_VBUS is an input of the carrier board from the external Host.

This interface is switched, through a dedicated USB switch SW controlled, with the USB interface necessary to manage the optional on-board modem described at par 3.3.2.

USB_OTG1+/USB_OTG1-: USB OTG Port #1 differential pair.

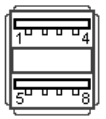
USB_OTG1_VBUS: USB voltage rail. It is an input for USB port working in Client mode, an output for Host mode.

USB_ID: Client/Host identification signal. This signal is high when the USB port works in client mode, is low when works in Host mode. VDD_3V3 electrical level with a 10KΩ pull-up resistor.

Please be aware that the USB Host mode on CN36 is allowed only if the ASTRID board is not equipped with the optional Modem module.

Dual USB 2.0 Type-A Socket – CN48			
Pin	**Signal**	**Pin**	**Signal**
1	$+5V_{USB1}$	5	$+5V_{USB2}$
2	USB1-	6	USB2-
3	USB1+	7	USB2+
4	GND	8	GND

The second USB interface is carried to a Microchip USB2514 USB2.0 Hub, which makes available four USB 2.0 downstream host ports.
The first and second downstream ports are carried to a double connector, CN48, which is a standard double USB Type A socket, shielded.
Since this connector is a standard type-A receptacle, it can be connected to all types of USB 1.1 / USB 2.0 devices using standard-A USB 2.0 plugs



USB1+/USB1-: USB Hub Downstream port #1 differential pair.

USB2+/USB2-: USB Hub Downstream port #2 differential pair.

Dual USB 2.0 pin Header – CN54			
Pin	**Signal**	**Pin**	**Signal**
1	$+5V_{USB3}$	2	$+5V_{USB4}$
3	USB3-	4	USB4-
5	USB3+	6	USB4+
7	GND	8	GND
		10	---

The other two downstream ports are hosted on a 9-pin p2.54mm pin header, h= 6mm, type NELTRON p/n 2213S-10G-E9 or equivalent, with the pinout shown in the tables on the left (it is a common pinout for USB headers in PC motherboards).

All USB ports' voltages ($+5V_{USBx}$ and +5V_USB_OTG) are derived, through a power switch IC, from +5V_A standby voltages.

USB3+/USB3-: USB Hub Downstream port #3 differential pair.

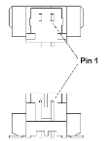
USB4+/USB4-: USB Hub Downstream port #4 differential pair.

Common mode chokes are placed on all USB differential pairs for EMI compliance.

For ESD protection, on all data and voltage lines are placed clamping diodes for voltage transient suppression.

3.3.10 Audio Connectors

Mono Speaker Connector – CN41	
Pin	**Signal**
1	AMP_SPEAKER_P
2	AMP_SPEAKER_N



ASTRID board integrates a Class-D amplifier MAX98357A from Maxim, which offers an amplified mono speaker output on a connector Molex type 53398-0271 as shown in the figure.

Mating connector: MOLEX 51021-0200 receptacle with MOLEX 50079-8000 female crimp terminals.

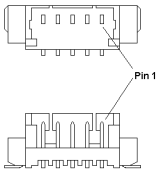
AMP_SPEAKER_P: Amplified speaker Positive Output

AMP_SPEAKER_N: Amplified speaker Negative Output

The power output available on this connector is (maximum theoretical value):

- Up to 1.8W on 8Ohm Load, up to 3.2W on 4Ohm load @ 10% Total Harmonic Distortion + Noise (THDN+N)
- Up to 1.4W on 8Ohm Load, up to 2.5W on 4Ohm load @ 1% THDN+N.

The i.MX8M Mini processor offers totally up to 8 channels Pulse Density Modulation (PDM) inputs. For this reason, on ASTRID board there are two connectors (CN42 and CN53) that can be used for the connection of two digital Microphones,



These connectors are type MOLEX 53398-0571 or equivalent, with the pinouts shown in the tables in the next page.

Mating connectors: MOLEX 51021-0500 receptacle with MOLEX 50079-8000 female crimp terminals.

MIC Connector right channel – CN42	
Pin	Signal
1	VDD_3V3
2	PDM_CLK
3	PDM_BIT_STREAM_RIGHT
4	SEL_RIGHT
5	GND

MIC Connector left channel – CN53	
Pin	Signal
1	VDD_3V3
2	PDM_CLK
3	PDM_BIT_STREAM_LEFT
4	SEL_LEFT
5	GND

PDM_CLK: PDM Clock for both Left and Right Digital microphone channels. VDD_3V3 electrical level

PDM_BIT_STREAM_RIGHT: PDM Data input for Audio Right Channel

PDM_BIT_STREAM_LEFT: PDM Data input for Audio Left Channel

SEL_RIGHT: Right Channel select signal. Tied to GND through a 0Ω pull-down resistor.

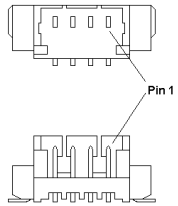
SEL_LEFT: Left Channel select signal. Tied to VDD_3V3 through a 0Ω pull-up resistor

3.3.11 Serial Ports Connectors

A53 Debug UART Connector – CN6	
Pin	Signal
1	VDD_3V3
2	A53_DUART_RX
3	A53_DUART_TX
4	GND

Onboard, connector CN6 carries out signals related to UART #2 interface from i.MX8M Mini processor. This interface can be used for the debugging of Cortex-A53 processors.

For this purpose, a dedicated 4-pin Connector, Type MOLEX p/n 53398-0471 or equivalent is provided. Mating connector: MOLEX 51021-0400 receptacle with MOLEX 50079-8000 female crimp terminals.



A53_DUART_RX: UART port #2 Receive signal, VDD_3V3 electrical level

A53_DUART_TX: UART port #2 Transmit signal, VDD_3V3 electrical level

M4 Debug UART Connector – CN21	
Pin	Signal
1	VDD_3V3
2	M4_DUART_RX
3	M4_DUART_TX
4	GND

The connector CN21, instead carries out signals related to UART #4 interface from i.MX8M Mini processor. This interface can be used for the debugging of Cortex-M4 processor.

Connector type is the same as CN6.

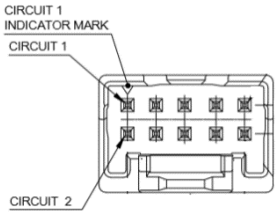
M4_DUART_RX: UART port #4 Receive signal, VDD_3V3 electrical level.

M4_DUART_TX: UART port #4 Transmit signal, VDD_3V3 electrical level.

3.3.12 I/O Connectors

I/O Connector #1– CN51	
Pin	**Signal**
1	+3V3_OUT
2	PWM3_3V3
3	PWM4_3V3
4	GPIO_OUT1
5	GPIO_OUT2
6	OUT5
7	OUT6
8	OUT7
9	OUT8
10	GND

I/O Connector #2– CN55	
Pin	**Signal**
1	+3V3_OUT
2	VOUT_EN
3	I2C_SDA_EXT_3V3
4	I2C_SCL_EXT_3V3
5	OUT_OD
6	OUT1
7	OUT2
8	OUT3
9	OUT4
10	GND



The ASTRID board offers the possibility of expanding its functionalities by using some additional interfaces, available on two dedicated 10 pin connectors, CN51 and CN55, which are connectors type Molex p/n 501645-1020.

Mating connector MOLEX 501646-1000 receptacle with MOLEX 501647, 501648 or 503096 series female crimp terminals.

The pinouts of these connectors are shown in the tables on the left.

Here following a complete description of the interfaces made available on these connectors:

VOUT_EN: Output enable signal, active high signal, VDD_3V3 electrical level.

I2C_SCL_EXT_3V3: External I2C Bus clock line. Output signal, electrical level +3V3_OUT with a 1K5Ω pull-up resistor. It is managed by the processor's I2C controller #3.

I2C_SDA_EXT_3V3: External I2C Bus data line. Bidirectional signal, electrical level +3V3_OUT with a 1K5Ω pull-up resistor. It is managed by the processor's I2C controller #3.

OUT_OD: Open Drain output, max 12V, max current 250mA

GPIO_OUT1, GPIO_OUT1: General purpose I/O signals, electrical levels VDD_3V3. Each one of these signals is filtered using a passive low-pass RC filter (T = 1µs) and protected with a D5V0F2U3LP TVS Diode.

PWM3_3V3: Filtered generic PWM output, electrical level VDD_3V3. This signal is filtered using a passive low-pass RC filter (T = 0.2ns) and protected with a D5V0F2U3LP TVS Diode. It is managed by i.MX8M Mini processor's Signal PWM3_OUT.

PWM4_3V3: Filtered generic PWM output, electrical level VDD_3V3. This signal is filtered using a passive low-pass RC filter (T = 0.2ns) and protected with a D5V0F2U3LP TVS Diode. It is managed by i.MX8M Mini processor's Signal PWM4_OUT.

OUT1..OUT8: the interfaces available on these pins depends on the factory alternative purchased. The possible alternative configuration, for each group of 4 pins (i.e. OUT1..OUT4 and OUT5…OUT..8) are:

- groups of 4x GPIOs
- RS-232 ports
- RS-485 ports
- CAN ports

This means that there are 16 possible configurations of these interfaces. Please be aware that the board's configuration with

the optional Ultra-Low Power RTC automatically implies the presence of CAN Port #2.

Depending on the combination of these interfaces, the meaning of signals OUT1..OUT8 is as shown in the following table

Factory Option	OUT1	OUT2	OUT3	OUT4	OUT5	OUT6	OUT7	OUT8
4x GPIO+4x GPIOs	GPIO1	GPIO2	GPIO3	GPIO4	GPIO5	GPIO6	GPIO7	GPIO8
4x GPIO+ RS-232 #2	GPIO1	GPIO2	GPIO3	GPIO4	RS232_2_TX	RS232_2_RTS	RS232_2_RX	RS232_2_CTS
4x GPIO+ RS-485 #2	GPIO1	GPIO2	GPIO3	GPIO4	RS485_2_D+	RS485_2_D-	/	/
4x GPIO+ CAN #2	GPIO1	GPIO2	GPIO3	GPIO4	/	/	CAN_2_H	CAN_2_L
RS-232 #1 + 4x GPIOs	RS232_1_TX	RS232_1_RTS	RS232_1_RX	RS232_1_CTS	GPIO5	GPIO6	GPIO7	GPIO8
RS-232 #1 + RS-232 #2	RS232_1_TX	RS232_1_RTS	RS232_1_RX	RS232_1_CTS	RS232_2_TX	RS232_2_RTS	RS232_2_RX	RS232_2_CTS
RS-232 #1 + RS-485 #2	RS232_1_TX	RS232_1_RTS	RS232_1_RX	RS232_1_CTS	RS485_2_D+	RS485_2_D-	/	/
RS-232 #1 + CAN #2	RS232_1_TX	RS232_1_RTS	RS232_1_RX	RS232_1_CTS	/	/	CAN_2_H	CAN_2_L
RS-485 #1 + 4x GPIOs	RS485_1_D+	RS485_1_D-	/	/	GPIO5	GPIO6	GPIO7	GPIO8
RS-485 #1 + RS-232 #2	RS485_1_D+	RS485_1_D-	/	/	RS232_2_TX	RS232_2_RTS	RS232_2_RX	RS232_2_CTS
RS-485 #1 + RS-485 #2	RS485_1_D+	RS485_1_D-	/	/	RS485_2_D+	RS485_2_D-	/	/
RS-485 #1 + CAN #2	RS485_1_D+	RS485_1_D-	/	/	/	/	CAN_2_H	CAN_2_L
CAN #1 + 4x GPIOs	/	/	CAN_1_H	CAN_1_L	GPIO4	GPIO5	GPIO6	GPIO7
CAN #1 + RS-232 #2	/	/	CAN_1_H	CAN_1_L	RS232_2_TX	RS232_2_RTS	RS232_2_RX	RS232_2_CTS
CAN #1 + RS-485 #2	/	/	CAN_1_H	CAN_1_L	RS485_2_D+	RS485_2_D-	/	/
CAN #1 + CAN #2	/	/	CAN_1_H	CAN_1_L	/	/	CAN_2_H	CAN_2_L

RS-232 / RS-485 port #1 is managed by i.MX8M Mini processor's UART interface #3.

RS-232 / RS-485 port #2 is managed by i.MX8M Mini processor's UART interface #4.

When the board is configured to have GPIOs on OUT1..OUT4 pins or on OUT5..OUT8 pins, the corresponding interface can be also used as an UART at TTL level.

RS232_1_RX : COM Port #3 RS-232 Mode Receive data

RS232_1_TX : COM Port #3 RS-232 Mode Transmit data

RS232_1_RTS : COM Port #3 RS-232 Mode Request to Send handshaking signal.

RS232_1_CTS : COM Port #3 RS-232 Mode Clear To Send handshaking signal

RS232_2_RX : COM Port #4 RS-232 Mode Receive data

RS232_2_TX : COM Port #4 RS-232 Mode Transmit data

RS232_2_RTS : COM Port #4 RS-232 Mode Request to Send handshaking signal.

RS232_2_CTS : COM Port #4 RS-232 Mode Clear To Send handshaking signal

RS485_1_D+/ RS485_1_D-: COM Port #3 RS-485 Mode, Differential Pair

RS485_2_D+/ RS485_2_D-: COM Port #4 RS-485 Mode, Differential Pair

CAN_1_H: High-Level CAN port#1 bus line.

CAN_1_L: Low-Level CAN port #1 bus line.

CAN_2_H: High-Level CAN port#2 bus line.

CAN_2_L: Low-Level CAN port #2 bus line.

In case that the configuration include CAN1 and CAN2 interfaces, two jumpers are included on board to set the termination resistor. JP1 and JP2 are 2-way jumpers.

JP1 position	CAN1 Bus Termination
Inserted	120 Ohm Termination enabled
Not inserted	120 Ohm Termination disabled

JP2 position	CAN2 Bus Termination
Inserted	120 Ohm Termination enabled
Not inserted	120 Ohm Termination disabled

For using the GPIOs according to i.MX8M Mini possibilities, it is here also shown the connection table to the i.MX8M Mini processor,

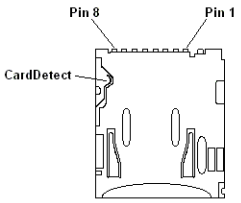
PIN Nr.	Pin Name	i.MX8M Mini Pad Name
CN55-6	OUT1	ECSPI1_MOSI
CN55-7	OUT2	ECSPI1_MISO
CN55-8	OUT3	ECSPI1_SCLK
CN55-9	OUT4	ECSPI1_SS0
CN51-6	OUT5	ECSPI2_MOSI
CN51-7	OUT6	ECSPI2_MISO
CN51-8	OUT7	ECSPI2_SCLK
CN51-9	OUT8	ECSPI2_SS0

3.3.13 microSD Slot

microSD Card Slot – CN56	
Pin	Signal
1	SD2_DATA2
2	SD2_DATA3
3	SD2_CMD
4	SD2_PWR
5	SD2_CLK
6	GND
7	SD2_DATA0
8	SD2_DATA1
CardDetect	SD2_CD_B

The NXP i.MX8M Mini family of processors embeds three Ultra Secured Digital Host controllers (uSDHC), able to support SD / SDXC Cards.

For this reason, on ASTRID board there is also a socket, for the use of standard microSD cards, which can be used as Mass Storage and/or Boot Devices.



The connector is a microSD connector, push-push type, H=1.68 mm, type JST DM3AT-SF-PEJM5 or equivalent.

SD2_CD_B: Card Detect Input.

SD2_CLK: SD Clock Line (output).

SD2_CMD: Command/Response bidirectional line.

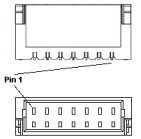
SD2_DATA[0÷3]: SD Card data bus. SD2_DATA0 signal is used for all communication modes. SD2_DATA[1÷3] signals are required for 4-bit communication mode.

SD2_PWR voltage is derived from VDD_3V3 power rail. It can be switched on and off via SW (USDHC2_RESET_B signal, managed using the i.MX8M Mini pad SD2_RESET_B).

3.3.14 JTAG Connector

JTAG Connector– CN3	
Pin	Signal
1	VDD_1V8
2	JTAG_TCK
3	JTAG_TMS
4	JTAG_TDI
5	JTAG_TDO
6	JTAG_TRST_B
7	GND

The i.MX8M Mini processors include a System JTAG Controller (SJC) providing debug and test control with the maximum security. On ASTRID board, the JTAG interface working is fixed to Debug mode and can be accessed through connector header CN3, type JST p/n SM07B-SRSS-TB or equivalent, with the pinout shown on the left table.

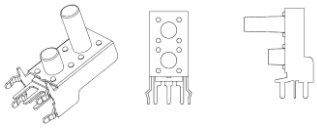


Mating connector: JST 07SR-3S receptacle with JST SSH-003T-P0.2-H female crimp terminals.

All these JTAG signals are directly connected to i.MX8 pins with same name. Please refer to i.MX8M Mini processor's documentation for a description of the signals and their usage.

3.3.15 ON/OFF and Reset Connector

ASTRID board can offer a dual push-button Switch (P/N TS-472-DBS-BB) for the On/Off and System Reset functionalities.

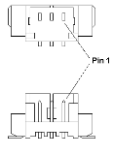


Upper push button is used for On/Off, while lower push button is used for Reset.

Please be aware that the dual push button switch is available only on board in commercial temperature range, since it cannot sustain the full industrial temperature range.

ON/OFF and Reset Connector – CN49	
Pin	**Signal**
1	RST
2	GND
3	ONOFF

Independently by the temperature range of the module purchased, it is always available an additional connector, CN49, which can be used to connect remote pushbuttons for System Reset and On/Off functionalities.



CN49 is a 1.25mm pitch 3-pin header, Type MOLEX p/n 53398-0371 or equivalent.

Mating connector: MOLEX 51021-0300 receptacle with MOLEX 50079-8000 female crimp terminals.

RST#: Reset Input, active Low signal. Electrical Level NVCC_SNVS_1V8 with 4.7kΩ pull-up resistor

ONOFF: Reset Input, active Low signal. Electrical Level NVCC_SNVS_1V8 with 4.7kΩ pull-up resistor

3.3.16 Boot Mode Select Jumper

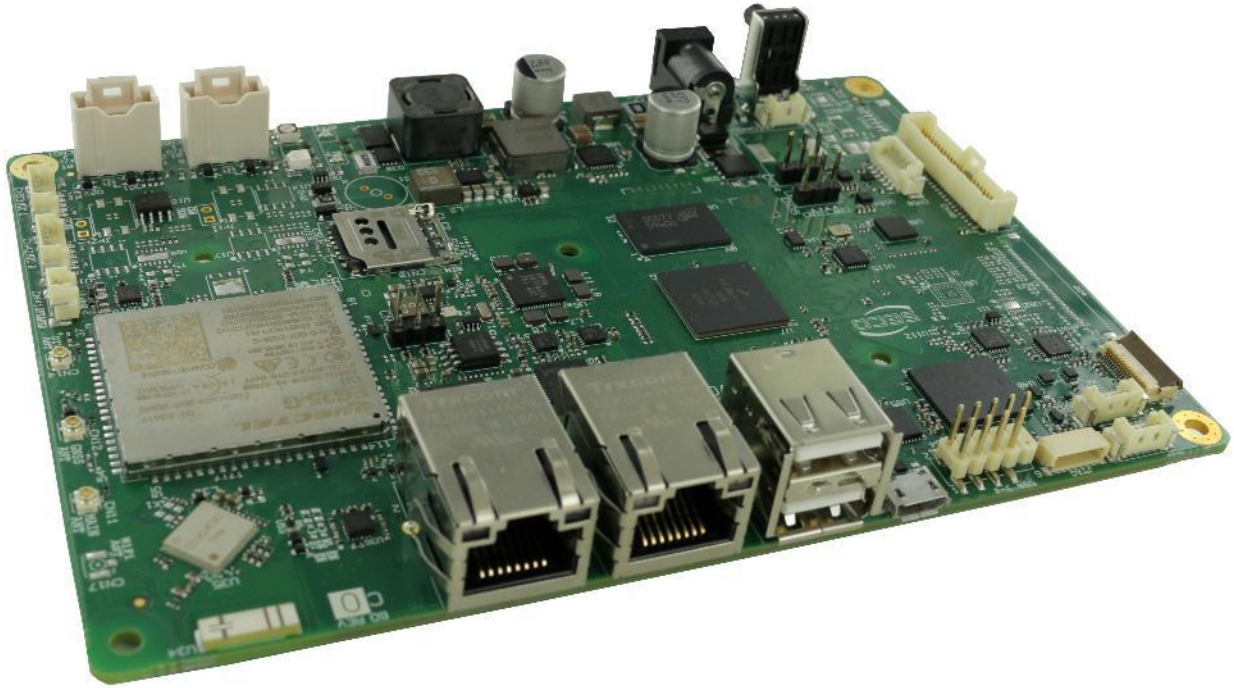
CN52 position	Boot Mode selection
1-2	Serial Downloader
2-3	microSD slot
Not inserted	on-board eMMC

The device from which the ASTRID board will boot can be selected using Jumper CN52 with three configurations indicated on the table to the left.

The Serial Downloader selection (position 1-2) provides an API over USB OTG (CN36). Therefore, an application can reside on a host PC that will control the boot of the i.MX 8M processor. This may be useful if you are working with a board that has an unprogrammed FLASH device or for debug purposes.

Chapter 4.
APPENDICES

- Thermal Design



4.1 Thermal Design

A parameter that has to be kept in very high consideration is the thermal design of the system.

Highly integrated modules, like ASTRID board, offer to the user very good performances in minimal spaces, therefore allowing the system's minimization. On the counterpart, the miniaturizing of IC's and the rise of operative frequencies of processors lead to the generation of a big amount of heat, that must be dissipated to prevent system hang-off or faults.

The board can be used along with specific heatspreaders, but please remember that they will act only as thermal coupling device between the board itself and an external dissipating surface/cooler. The heatspreader also needs to be thermally coupled to all the heat generating surfaces using a thermal gap pad, which will optimize the heat exchange between the module and the heatspreader.

The heatspreader is not intended to be a cooling system by itself, but only as means for transferring heat to another surface/cooler, like heatsinks, fans, heat pipes and so on.

When using ASTRID boards, it is necessary to consider carefully the heat generated by the module in the assembled final system, and the scenario of utilization.

Until the board is used on a laboratory shelf, on free air, just for software development and system tuning, then a heatsink with integrated fan could be sufficient for board's cooling. Anyhow, please remember that all depends also on the workload of the processor. Heavy computational tasks will generate much heat with all SOCs versions.

Therefore, it is always necessary that the customer studies and develops accurately the cooling solution for his system, by evaluating processor's workload, utilization scenarios, the enclosures of the system, the air flow and so on.

SECO can provide ASTRID specific passive heatsinks, but please remember that their use must be evaluated accurately inside the final system, and that they should be used only as a part of a more comprehensive ad-hoc cooling solutions.

Ordering Code	Description
ASK-948	Heatsink unit for ASTRID board

Warning!

The thermal solutions available with SECO boards are validated and certificated according to IEC 62368-1 in the temperature range [-40°C-75°C], without housing and inside climatic chamber. Therefore, the customer is suggested to study, develop and validate the cooling solution for his system, considering ambient temperature, processor's workload, utilisation scenarios, enclosures, air flow and so on.

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