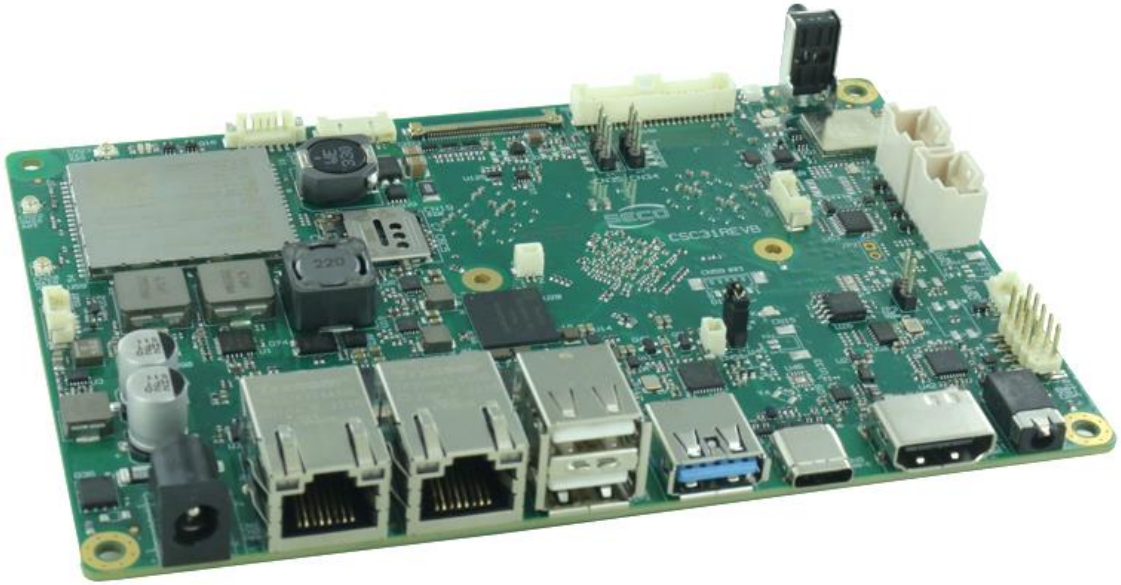
SBC

User Manual



SBC-C31

Single Board Computer
with Rockchip RK3399 SoC
on 3.5” form factor

SECO

www.seco.com

REVISION HISTORY

Revision	Date	Note	Ref
1.0	18th October 2021	First Official Release.	AR

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).

Our team is ready to assist.

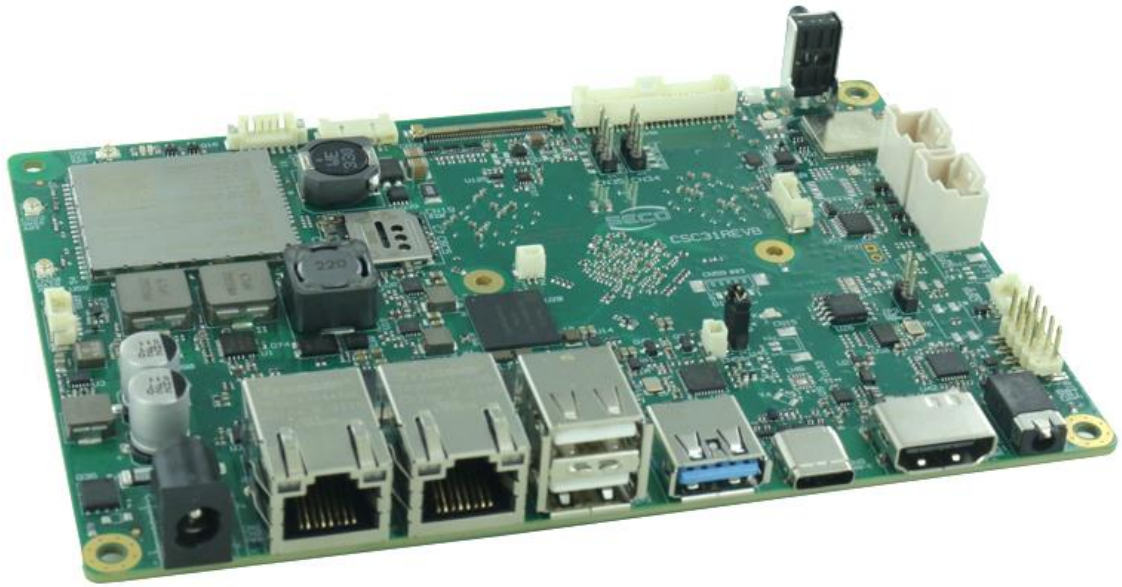
INDEX

Chapter 1. INTRODUCTION 5
1.1 Warranty 6
1.2 Information and assistance 7
1.3 RMA number request 7
1.4 Safety 8
1.5 Electrostatic discharges 8
1.6 RoHS compliance 8
1.7 Safety Policy 9
1.8 Terminology and definitions 10
1.9 Reference specifications 12
Chapter 2. OVERVIEW 13
2.1 Introduction 14
2.2 Technical specifications 15
2.3 Electrical specifications 16
2.3.1 RTC Battery 16
2.3.2 Power rails 17
2.3.3 Power consumption 18
2.4 Mechanical specifications 20
2.5 Block diagram 21
Chapter 3. CONNECTORS 22
3.1 Introduction 23
3.2 Connectors overview 24
3.2.1 Connector List 24
3.2.2 Jumpers List 24
3.3 Connectors description 25
3.3.1 Gigabit Ethernet connectors 25
3.3.2 On board optional modem 26
3.3.3 On board WiFi + BT module 26
3.3.4 LVDS connector 27
3.3.5 eDP Connector 29
3.3.6 HDMI Connector 30
3.3.7 USB Connectors 31

3.3.8 MIPI-CSI2 Connectors....33
3.3.9 microSD Card Slot....34
3.3.10 Audio interface....34
3.3.11 I2C T/S Connector....35
3.3.12 CAN Connectors....35
3.3.13 I/O Connectors....36
3.3.14 LED Driver Connector....38
3.3.15 Serial Ports Connector....38
3.3.16 Power and Reset Header....38
3.3.17 SPI Connector....39
3.3.18 RECOVERY MODE connectors....39
Chapter 4. APPENDICES....40
4.1 Thermal Design....41

Chapter 1.
INTRODUCTION

- Warranty
- Information and assistance
- RMA number request
- Safety
- Electrostatic discharges
- RoHS compliance
- 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 authorized by the supplier.

The authorization is released after completing the specific form available on the website http://www.seco.com/en/prerma (RMA Online). The RMA authorization 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 the 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 SBC-C31 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 SBC-C31 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 SBC-C31 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 SBC-C31 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 SBC-C31 Module shall be:

- used exclusively inside a fire enclosure made of non-combustible material or V-1 material (the fire enclosure is not necessary if the maximum power supplied to the board never exceeds 100 W, even in worst-case fault);
- used inside an enclosure provided with the symbol IEC 60417-5041 (element 1a according to clause 9.5.2 of the IEC 62368-1) on the external part;
- used inside an enclosure compliant with all applicable IEC 62368-1 requirements
- 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. The board in its enclosure must be evaluated for temperature and airflow considerations.
- installed in a way that prevents the access to the board from children

The manufacturer which include a SBC-C31 module in his end-user product shall:

- verify the compliance with all applicable clauses of the IEC 62368-1 in its own final operating condition;
- check that all connections from or to the board are compliant to ES1 requirements;
- 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.
CEC	Consumer Electronics Control, an HDMI feature which allows controlling more devices connected together by using only one remote control
CSI2	MIPI Camera Serial Interface, 2nd generation standard regulating communication between a peripheral device (camera) and a host processor
DDC	Display Data Channel, a kind of I2C interface for digital communication between displays and graphics processing units (GPU)
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
GPU	Graphics Processing Unit
HDMI	High Definition Multimedia Interface, a digital audio and video interface
I2C Bus	Inter-Integrated Circuit Bus, a simple serial bus consisting only of data and clock line, with multi-master capability
I2S	Inter-Integrated Circuit Sound, an audio serial bus protocol interface developed by Philips (now NXP) in 1986
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
SIM	Subscriber Identity Module, a card which stores all data of the owner necessary to allow him accessing to mobile communication networks
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
TMDS	Transition-Minimized Differential Signalling, a method for transmitting high speed serial data, normally used on DVI and HDMI interfaces
TTL	Transistor-transistor Logic
UIM	User Identity Module, an extension of SIM modules.
USB	Universal Serial Bus
uSDHC	Ultra Secure Digital Host Controller
V_REF	Voltage reference Pin

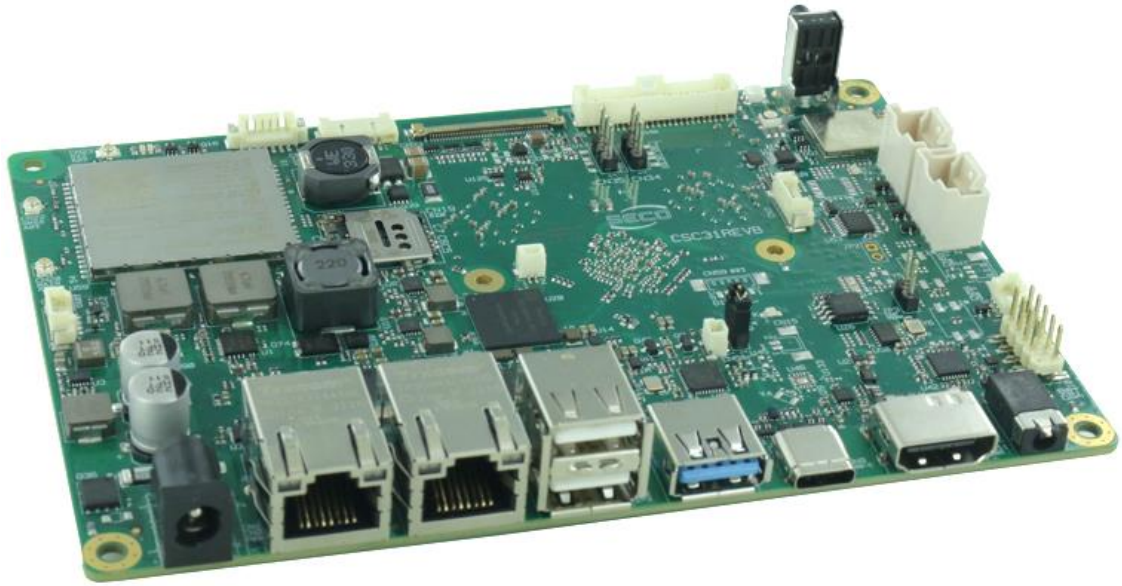
1.9 Reference specifications

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

Reference	Link
AzureWave AW-CM276NF	AW-CM276NF_DS_0B_A_STD.pdf (azurewave.com)
CAN Bus	https://www.iso.org/standard/63648.html
CSI	http://www.mipi.org/specifications/camera-interface
DDC	http://www.vesa.org
DP, eDP	http://www.vesa.org
FastEthernet	http://standards.ieee.org/about/get/802/802.3.html
Gigabit Ethernet	https://www.ieee802.org/3/
HDMI	http://www.hdmi.org/spec/index
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
OpenGL	http://www.opengl.org
OpenVG	http://www.khronos.org/openvg
PCI Express	http://www.pcisig.com/specifications/pciexpress
Quectel EG25 Modem	https://www.quectel.com/UploadFile/Product/Quectel_EG25-G_LTE_Specification_V1.1.pdf
Rockchip RK3399	RK3399 - Rockchip Wiki (wikidot.com)
SD Card Association	https://www.sdcard.org/home
SDIO	https://www.sdcard.org/developers/overview/sdio
TMDS	http://www.siliconimage.com/technologies/tmds
USB 2.0 and USB OTG	https://www.usb.org/sites/default/files/usb_20_20190524.zip
USB 3.0	https://usb.org.10-1-108-210.causewaynow.com/sites/default/files/usb_32_20191024.zip

Chapter 2.
OVERVIEW

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



2.1 Introduction

SBC-C31 is a Single Board Computer in 3.5" form factor (which is 146 x 102mm) based on embedded Rockchip RK3399 processor, featuring Dual-core ARM® Cortex®-A72 MPCore processor and Quad-core ARM Cortex®-A53 MPCore processor, with frequencies up to 1.8GHz, which are ideal for applications requiring multimedia capabilities.

Graphics features of the board are managed directly by Rockchip RK3399 processor, which integrate a 4-Core Mali-T860MP4 GPU, supporting OpenGL ES 1.1/2.0/3.0/3.1, OpenVG 1.1, OpenCL, DirectX11.1.

HW video decoding of the most common coding standard (i.e., H.265 10-bit, H.264 10-bit, VP9 8-bit, MPEG-4, MPEG-2, VP8 and others) is supported. Also H.264, VP8 encoding is supported.

The board is completed with up to 4GB LPDDR4 64-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, one eDP interface, one HDMI standard interface for HDMI1.4 / 2.0a compliant displays and one DP 1.2 interface on USB Type-C connector (alternate mode).

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 SBC-C31 board offers two USB 3.0, one on standard Type-C connector and one on standard Type-A connector, two USB 2.0 on standard Dual Type-A connector, an internal header with up to two additional USB 2.0 Host ports (one of this is shared with the optional modem).

The audio functionalities of this board are realised by an I2S audio codec, which manages Line out and Mic In interfaces on a combo TRRS audio jack.

Two internal connectors extend 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 4xGPIOs + 1x RS-232, plus given by default 3x GPIOs, 1x Open-Drain Output, 1x I2C and 1x PWM.

The features on SBC-C31 are completed , as factory options, by 1x CAN or SPI flash on-board or SPI external interface, plus by 1x CAN or Ultra Low Power RTC on-board. Last but not least, SBC-C31 can offer up to two MIPI CSI serial camera interfaces.

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

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

2.2 Technical specifications

Processors

Rockchip RK3399 processor, 2x Cortex®-A72 MP cores + 4x Cortex®-A53 MPCores, up to 1.8GHz, 64-bit architecture

Memory

Soldered-down LPDDR4 memory, up to 4GB total, 64-bit interface

Graphics

4-Core Mali-T860MP4 GPU
OpenGL ES 1.1/2.0/3.0/3.1, OpenVG 1.1, OpenCL, DX11 support
Embedded VPU, able to offer:

- H.265 10-bit, H.264 10-bit, VP9 8-bit 4Kx2K@60fps HW Decoding
- MPEG-4/MPEG-2/VP8 1080p@60fps HW Decoding
- H.264, VP8 1080p@30fps HW encoding

Supports 2 independent video outputs

Video Interfaces

LVDS Single / Dual Channel interface
eDP 1.3 interface
HDMI 4K interface
DP 1.2 interface on USB Type-C connector (alternate mode)

Video Resolution

HDMI, DP: Up to 4K x 2K @60Hz
eDP: Up to 4096 x 2160 (4K)
LVDS: Up to 1920 x 1080 @60Hz

Mass Storage

SPI Flash (alternative to CAN Controller #1)
eMMC 5.1 Drive soldered on-board
microSD slot

Networking

Up to 2 x Gigabit Ethernet ports
Optional soldered onboard M.2 1216 WLAN 802.11 a/b/g/n/ac + BT 5.0 module
Optional on-board LTE Modem

USB

1x USB 3.0 Type-C port (Alternate mode with DP)
1x USB 3.0 Host port on Type-A socket
2x USB 2.0 Host ports on Dual Type-A socket
Up to 2x USB 2.0 Host ports on internal pin header

Audio

Optional I2S Audio Codec w/ TRSS Jack (MicIn / Lineout)

Serial ports

1x Debug UART
Up to 2x RS-232 (factory options)
Up to 2x RS-485 (factory options)
Up to 2x CAN ports (factory options)

Other Interfaces

Optional 2x MIPI-CSI Camera connectors, 4-lanes CSI input each one
miniSIM slot or eSIM for on-board optional modem
I/O Connector #1 with I2C interface + 1x Open-Drain + (RS-232 or RS-485 - factory alternatives)
I/O Connector #2 with 3x GPIOs + 1x PWM + (RS-232 or RS-485 or TTL UART - factory alternatives)
Dedicated connector for I2C Touch Screen Controller Support
Optional Ultra-low Power RTC (Alternative to CAN Controller #2)
Optional SPI external interface (alternative to CAN Controller #1)
Optional LED Driver
Optional Trust Secure Element on-board

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

Operating temperature:

Commercial version: 0°C ÷ +60°C
Extended version: -20°C ÷ +85°C

Dimensions: 146 x 102 mm (3.5" form factor)

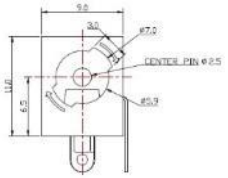
Supported Operating Systems:

Linux Yocto
Android (under development)

! *** 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

SBC-C31 board needs to be supplied with any voltage in the range +12V_{DC} ÷ +24V_{DC} range. All the other voltages necessary for the working of the board and of the connected peripherals are derived from the main V_{IN} power rail.

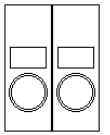


It is possible to supply the module by using two different power connectors (factory alternatives).

The first possible power connector for VIN voltage is a standard 5.9mm (internal pin, diameter 2.5 mm) DC Power Jack, locking type, CN1.

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.

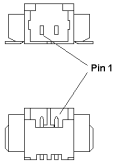


2.3.1 RTC Battery

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. Battery used is a cabled CR2032-LD Lithium coin-cell battery, with a nominal capacity of 210mAh.

Battery connector – CN15	
Pin	**Signal**
1	V_{RTC}
2	GND

The battery is not rechargeable and can be connected to the board using dedicated connector CN15 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 SBC-C31 are compliant to requirements of European Directive 2006/66/EC regarding batteries and accumulators. When putting out of order SBC-C31, 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 +12VDC ..+24VDC) directly coming from the Power Supply connectors CN1 or CN2

V_{RTC}: 3V power rail for supplying the optional Ultra Low Power RTC

+12V_ALW: +12V power rail, directly generated from VIN power rail, immediately available when VIN voltage is applied

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

+3V3_ALW: +3.3V power rail, directly generated from VIN power rail, immediately available when VIN voltage is applied and 5V_ALW voltage is stable

+5V_RUN: main +5V power rail generated by the +5V_ALW power rail and enabled by the on-board PMIC

+3V3_RUN: main +3.3V power rail generated by the +3V3_ALW power rail and enabled by the on-board PMIC

+1V8_RUN: main +1.8V power rail generated and enabled by the on-board PMIC

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

2.3.3 Power consumption

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

Configuration #1

Processor Rockchip RK3399K;
RAM: 4GB LPDDR4;
Storage: 32GB eMMC;
Video Interface: HDMI + LVDS + eDP + LED Driver;
Networking: 2x Gigabit LAN + Modem LTE with eSIM + WiFi / BT with PCB Antenna;
Expansion interfaces: 1x RS-485 + 4x GPIOs
Other: SPI Flash on-board, Audio Codec
Linux OS
Extended Temperature range

13.3" eDP panel type BOE connected

Configuration #2

Processor Rockchip RK3399;
RAM: 4GB LPDDR4;
Storage: 64GB eMMC;
Video Interface: HDMI + LVDS + eDP + LED Driver;
Networking: 2x Gigabit LAN + Modem LTE with eSIM + WiFi / BT with PCB Antenna;
Expansion interfaces: 2x RS-232
Other: SPI Flash on-board, Audio Codec, RTC battery
Linux OS
Commercial Temperature range

21.5" LVDS display type AUO P215HVN01.0 connected

Configuration #3

Processor Rockchip RK3399;
RAM: 4GB LPDDR4;
Storage: 64GB eMMC;
Video Interface: HDMI + LVDS + eDP + LED Driver;
Networking: 2x Gigabit LAN + Modem LTE with eSIM + WiFi / BT with PCB Antenna;
Expansion interfaces: 1x RS-485 + 1x RS-232
Other: SPI Flash on-board, Audio Codec, RTC battery

Linux OS
Commercial Temperature range

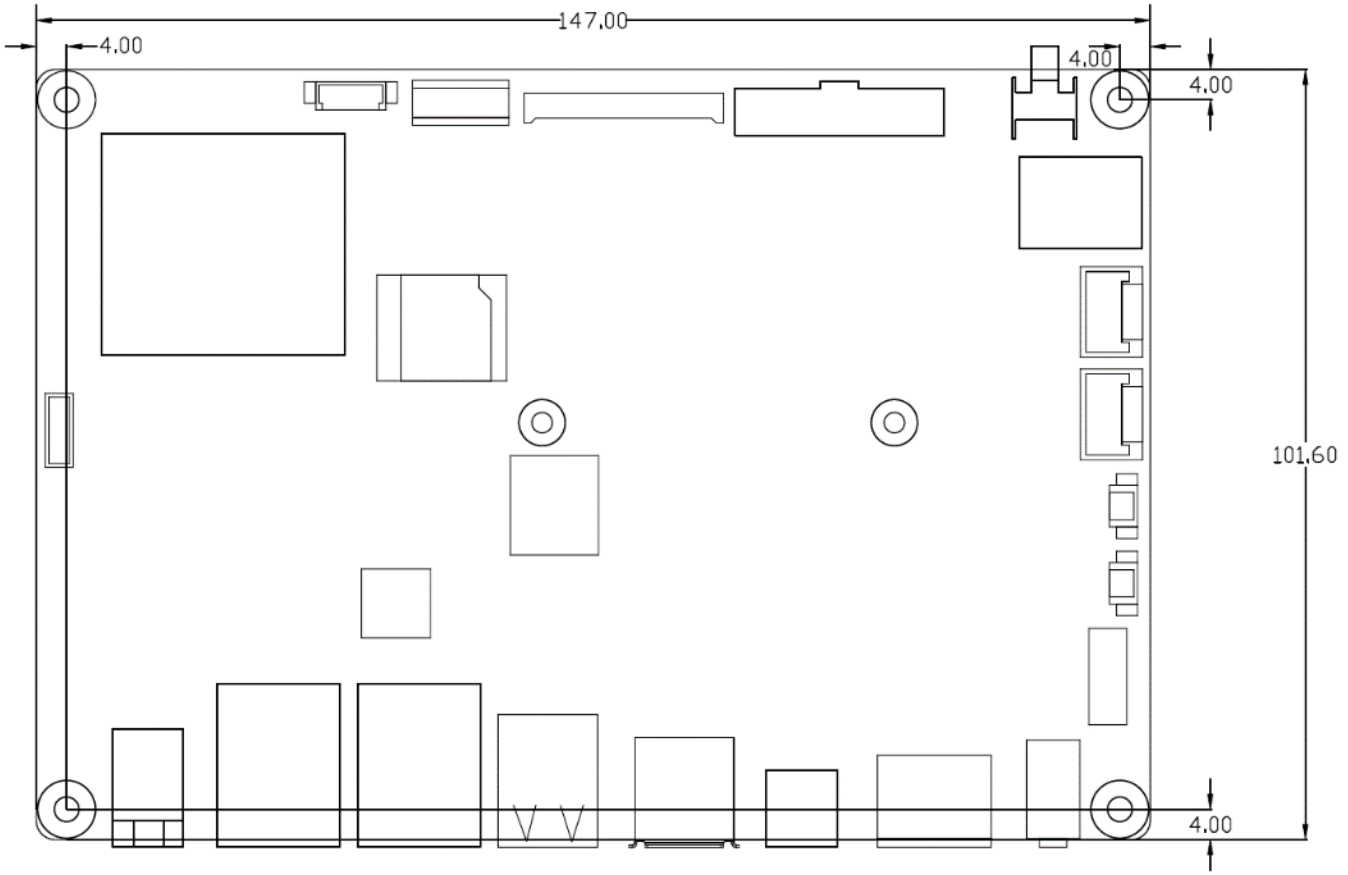
HDMI Panel connected

Status	Configuration #1				Configuration #2				Configuration #3			
	Average Value (30s)		Peak Value		Average Value (30s)		Peak Value		Average Value (30s)		Peak Value	
Idle (same for all configurations)	2.09W	0.11A	2.28W	0.12A	2.09W	0.11A	2.28W	0.12A	2.09W	0.11A	2.28W	0.12A
OS BOOT	8.36W	0.44A	11.97W	0.63A	17.1W	0.9A	20.9W	1.1A	3.8W	0.2A	7W	0.37A
Stress Test	11.4W	0.6A	12.92W	0.68A	22.61W	1.19A	23.56W	1.24A	8.17W	0.43A	9.5W	0.5A

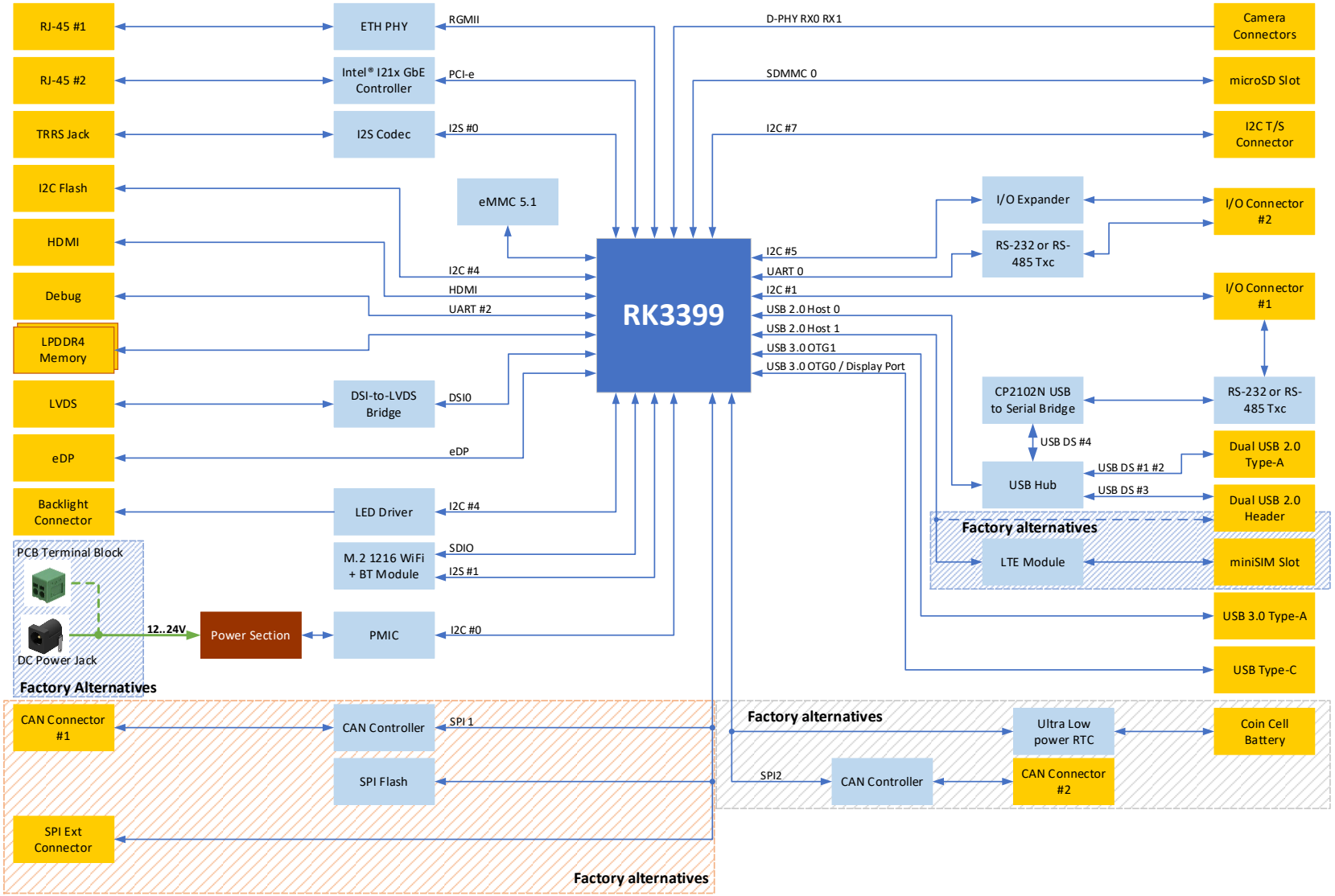
2.4 Mechanical specifications

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 twelve layers, some of them are ground planes, for disturbance rejection.

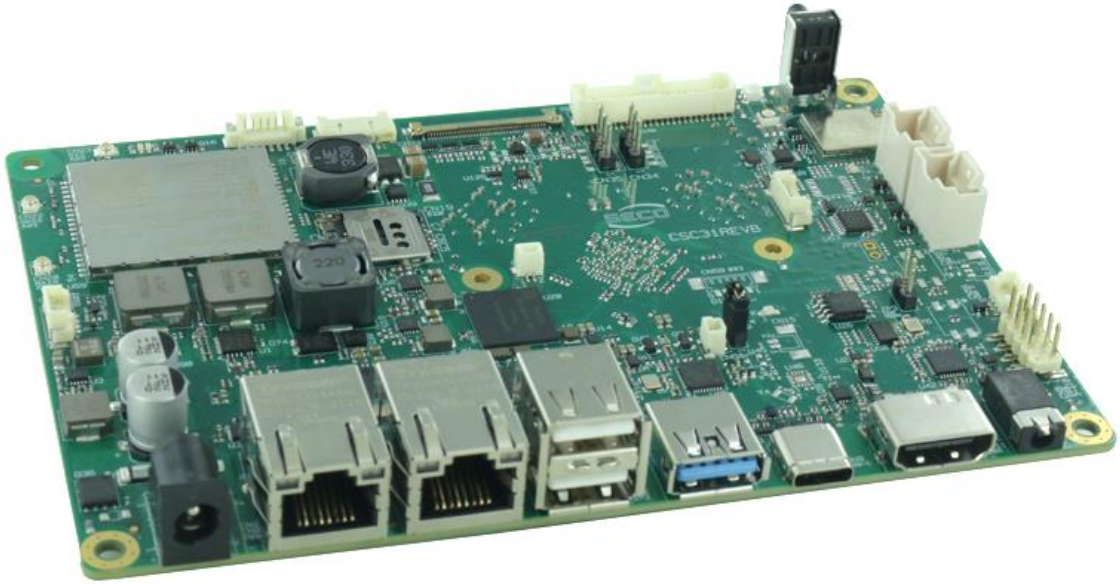


2.5 Block diagram



Chapter 3.
CONNECTORS

- Introduction
- Connectors overview
- Connectors description

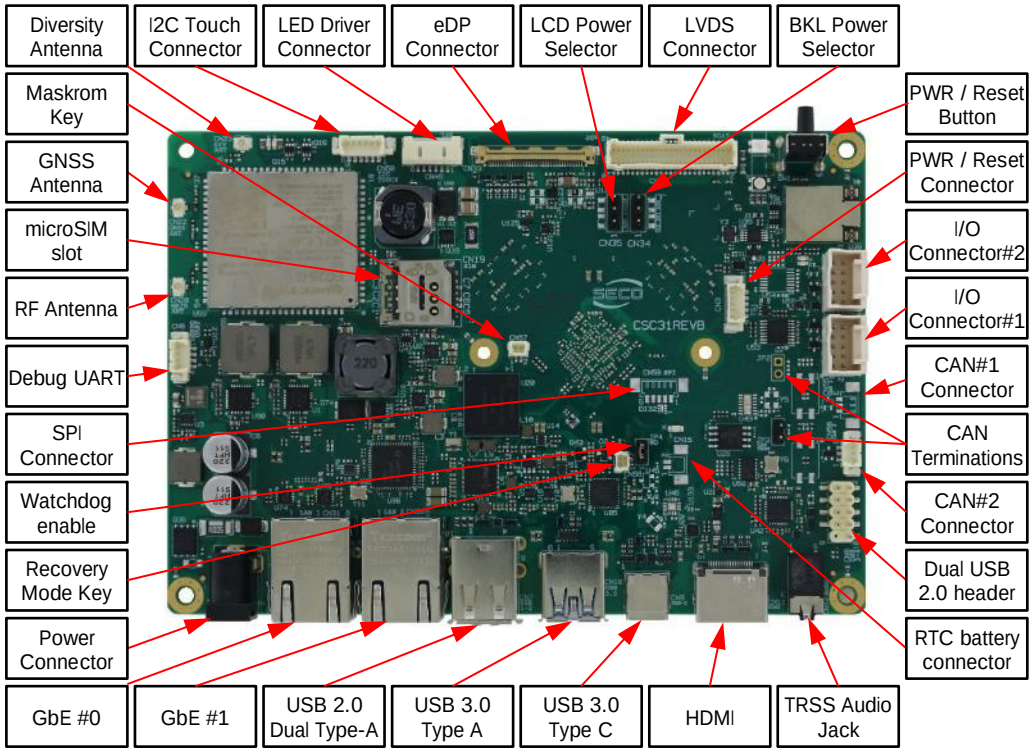


3.1 Introduction

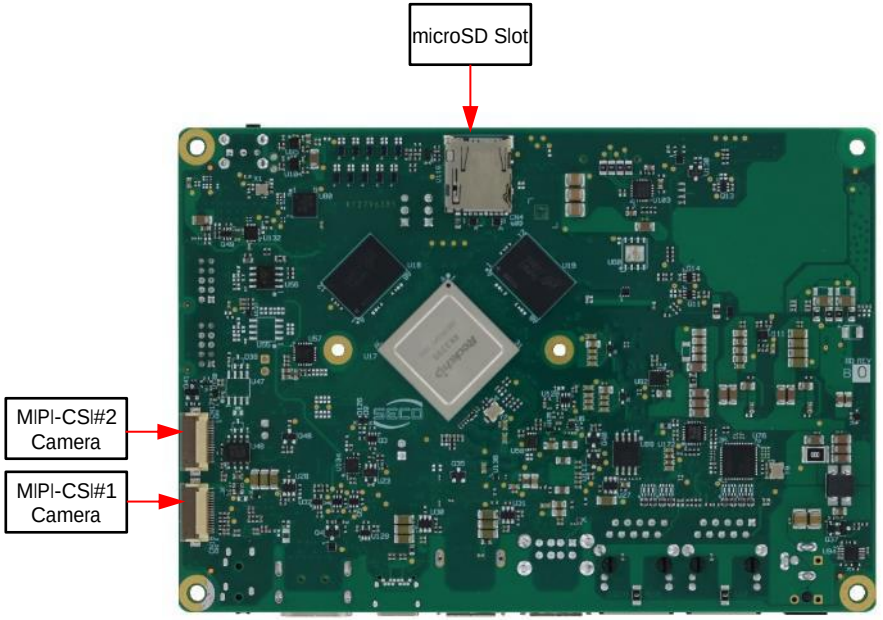
On SBC-C31 board, there are several connectors located on the lower plane. Standard connectors are placed on the same side of PCB, so that it is possible to place them on a panel of an eventual enclosure.

> ! 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	DC Power Jack	CN23	Div External Antenna u.FL Connector
CN2	DC Power PCB Terminal Block	CN31	GbE #0 RJ-45 Connector
CN3	Power and Reset Connector	CN33	eDP Connector
CN4	microSD Card Slot	CN34	LCD Power Selector
CN6	Debug UART Connector	CN35	Backlight Power Selector
CN7	Dual USB 2.0 Type A Connector	CN38	GbE #1 RJ-45 Connector
CN8	Dual USB 2.0 pin header	CN40	LVDS Connector
CN9	USB 3.0 Type C Connector	CN46	LED Driver Connector
CN10	USB 3.0 Type A Connector	CN50	I2C Touch Connector
CN11	HMDI Connector	CN51	I/O Connector #1
CN12	TRSS Audio Jack	CN52	I/O Connector #2
CN15	Cabled Coin Cell Battery RTC Connector	CN55	CAN Bus #1 Connector
CN16	MIPI-CSI #1 Camera Connector	CN56	CAN Bus #2 Connector
CN17	MIPI-CSI #2 Camera Connector	CN57	Maskrom Key connector
CN19	microSIM Slot	CN58	Recovery mode key connector
CN20	RF Main External Antenna u.FL Connector	CN59	SPI Connector
CN22	GNSS External Antenna u.FL Connector	SW1	Power / Reset Button

3.2.2 Jumpers List

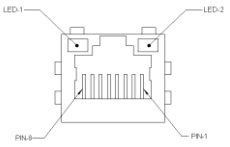
Name	Description	Name	Description
JP2	CAN Bus#1 Termination	JP4	Watchdog enable
JP3	CAN Bus#2 Termination		

3.3 Connectors description

3.3.1 Gigabit Ethernet connectors

GbEthernet RJ-45 Connector #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 GbEthernet RJ-45 Connector #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 SBC-C31 to two different wired LANs.

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

The second Ethernet connection is realised by using Intel® I210 family Gigabit Ethernet controller interfaced to Rockchip 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 LINK-PP p/n LPJG16314A4NL 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 SBC-C31 board can be equipped with one embedded LTE Cat 4 modem module (optional), type QUECTEL EG25-G.

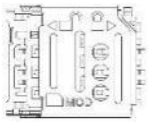
This optional Modem module supports:

- 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 CN20 for RF Antenna
- U.FL connector CN22 for GNSS Antenna (the module is ready for the connection of active antennas)
- U.FL connector CN23 for Diversity Antenna

microSIM Card Slot – CN19			
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 microSIM slot CN19 or to the eSIM onboard. Boards equipped with the microSIM 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 microSIM card provided by any telecommunication operator for the connection to their network.

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

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

UIM_CLK: Clock line, output from EG25-G module to the microSIM module.

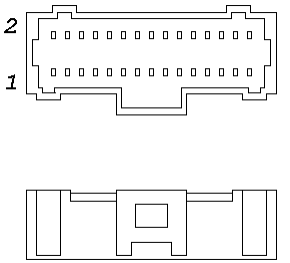
UIM_PWR: Power line for the microSIM module. Can be 1.8V or 3.3V, it is supported by the EG25-G module automatically.

3.3.3 On board WiFi + BT module

The SBC-C31 board can be equipped with a Dual band (2.4GHz + 5.0 GHz) WLAN 802.11 a/b/g/n/ac + BT 5.0 combo embedded module, which is AzureWave Type, p/n AW-CM276NF.

3.3.4 LVDS connector

LVDS connector – CN40			
Pin	Signal	Pin	Signal
1	LVDS_LCD_PWR	2	LVDS_BKLT_PWR
3	LVDS_LCD_PWR	4	LVDS_BKLT_PWR
5	LVDS_LCD_PWR	6	LVDS_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	LVDS_BKLT_EN	42	LVDS_BKLT_PWM
43	BKLT_AN_CTRL	44	PVCC_EN
45	I2C_SCL	46	TOUCH_RST
47	I2C_SDA	48	TOUCH_INT#
49	I2C_SDA	50	I2C_SCL



SBC-C31 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 1920x1200 @ 60Hx (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 (LVDS_LCD_PWR and LVDS_BKLT_PWR) and control signals (LCD enable signal, PVCC_EN, Backlight enable signal, LVDS_BKLT_EN, and Backlight Brightness Control signal with pulse width modulation and analog control, LVDS_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.

LVDS_BKLT_EN: LVDS_LCD_PWR electrical level Output with a 1kΩ pull-up resistor, Backlight Enable signal. It can be used to turn On/Off the backlight's lamps of connected displays.

PVCC_EN: LVDS_LCD_PWR electrical level Output with a 1kΩ pull-up resistor, Panel Power Enable signal. It can be used to turn On/Off the connected display.

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

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

I2C_SCL: I2C Bus clock line. Bidirectional signal, electrical level +3.3V_RUN with a 2K2Ω pull-up resistor. It is managed by the processor's I2C controller #5.

I2C_SDA: I2C Bus data line. Bidirectional signal, electrical level +3.3V_RUN with a 2K2Ω pull-up resistor. It is managed by the processor's I2C controller #5.

TOUCH_RST: +3.3V_RUN 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#: +3.3V_RUN 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	LVDS LCD Power selector
1-2	+3.3V_ALW
2-3	+5V_ALW

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

CN35 position	LVDS Backlight Power selector
1-2	+5V_ALW
2-3	+12V_ALW

LVDS_BKLT_PWR: Backlight switched voltage rail. Its value can be set to +5V_ALW or +12V_ALW by using dedicated jumper CN35, same type of CN34.

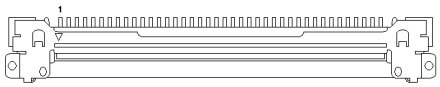
Since the use of jumpers in environments with vibrations issues could be a problem, it is possible to provide SC31 boards with the LCD Power and Backlight Power fixed at the desired value. For this purpose, some dedicated 0-Ohm resistors can be mounted (factory default: not available). Please contact your local Sales rep in case you need this special configuration.

3.3.5 eDP Connector

eDP connector - CN33			
Pin	Signal	Pin	Signal
1	---	21	eDP_LCD_PWR
2	eDP_BKLT_PWR	22	eDP_LCD_PWR
3	eDP_BKLT_PWR	23	eDP_LCD_PWR
4	eDP_BKLT_PWR	24	GND
5	eDP_BKLT_PWR	25	eDP_AUX_N
6	---	26	eDP_AUX_P
7	---	27	GND
8	eDP_BKLT_PWM	28	eDP_ML0P
9	eDP_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	eDP_LCD_PWR	40	---

SBC-C31 offers, a dedicated embedded Display Port interface.

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).



eDP_LCD_PWR can be factory regulated to be connected to +5V_ALW or +3.3V_ALW, while eDP_BKLT_PWR can be factory regulated to be connected to +5V_ALW or +12V_ALW.

These are factory configurations, please take care of specifying which is the configuration needed for eDP_LCD_PWR and eDP_BKLT_PWR voltage rail.

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.

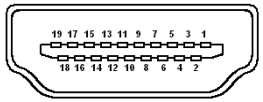
eDP_BKLT_EN: eDP_LCD_PWR electrical level Output with a 1kΩ pull-up resistor, Backlight Enable signal. It can be used to turn On/Off the backlight's lamps of connected displays.

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

3.3.6 HDMI Connector

HDMI Connector – CN11			
Pin	**Signal**	**Pin**	**Signal**
1	HDMI_TX2+	2	GND
3	HDMI_TX2-	4	HDMI_TX1+
5	GND	6	HDMI_TX1-
7	HDMI_TX0+	8	GND
9	HDMI_TX0-	10	HMDI_CLK+
11	GND	12	HDMI_CLK-
13	CEC	14	---
15	SCL	16	SDA
17	GND	18	$+5V_{HDMI}$
19	HPD		

RK3399 SoC has an embedded HDMI Tx module, which provides a HDMI standard interface for HDMI1.4 / 2.0a compliant displays.



For this reason, on SBC-C31 board there is the possibility of directly connecting one HDMI display, using a certified HDMI connector (HDMI type A), CN11, type WINNING p/n WHDM-19F3L1BN5U4.

Signals involved in HDMI management are the following:

HDMI_CLK+/HDMI_CLK-: HDMI differential Clock.

HDMI_TX0+/HDMI_TX0-: HDMI differential pair #0

HDMI_TX1+/HDMI_TX2-: HDMI differential pair #0

HDMI_TX2+/HDMI_TX3-: HDMI differential pair #0

SDA: DDC Data line for HDMI panel. Bidirectional signal, electrical level $+5V_{HDMI}$ with a 1k8Ω pull-up resistor

SCL: DDC Clock line for HDMI panel. Bidirectional signal, electrical level $+5V_{HDMI}$ with a 1k8Ω pull-up resistor

CEC: HDMI Consumer Electronics Control (CEC) Line. Bidirectional signal, electrical level +3.3V_ALW with a 27kΩ pull-up resistor

HPD: Hot Plug Detect Input signal, 5V tolerant, with a 100kΩ pull-down resistor

$+5V_{HDMI}$: Power voltage reference for HDMI, directly derived from +5V_RUN

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

Always use HDMI-certified cables for the connection between the board and the HDMI display; a category 2 (High-Speed) cable is recommended for higher resolutions, category 1 cables can be used for 720p resolution.

3.3.7 USB Connectors

RK3399 SoC embeds two USB 2.0 and two USB 3.0 controllers, which allow to implement, on-board, the following interfaces:

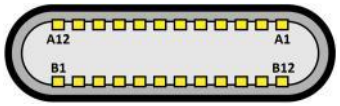
- 1x USB 3.0 Type C port on connector CN9 (used as Display Port 1.2 interface in Alternate Mode)
- 1x USB 3.0 Host Port on Type A socket CN10
- 2 x USB 2.0 Host ports on Dual Type-A socket CN7
- 2 x USB 2.0 Host ports on internal pin header CN8

USB 3.0 port#0 type C receptacle – CN9

Pin	Signal	Pin	Signal
A1	GND	B12	GND
A2	USBC0_SSTXA+	B11	USBC0_SSRXA+
A3	USBC0_SSTXA-	B10	USBC0_SSRXA-
A4	VBUS_C0	B9	VBUS_C0
A5	USBC0_CC1	B8	USBC0_SBU2
A6	USB0_A+	B7	USB0_B-
A7	USB0_A-	B6	USB0_B+
A8	USBC0_SBU1	B5	USBC0_CC2
A9	VBUS_C0	B4	VBUS_C0
A10	USBC0_SSRXB-	B3	USBC0_SSTXB-
A11	USBC0_SSRXB+	B2	USBC0_SSTXB+

USB 3.0 port #0 is available on standard Type-C connector CN9, with DisplayPort Alternate Mode Support. This means that USB type-C connector can be used to connect external USB devices as well as DP/HDMI displays. This port has also OTG functionalities support.

In addition, USB Type-C is a flippable connector, meaning that this interface is designed in a way that the plug can be flipped relative to the receptacle. The redundancy for the signal on Row A and B is included only to provide a flippable connector.



Signal description of this port:

USBC0_SSTXx+ USBC0_SSTXx-: USB Super Speed Port #0 transmit signal differential pair

USBC0_SSRXx+ USBC0_SSRXx-: USB Super Speed Port #0 receive signal differential pair

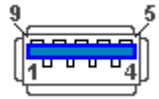
USB0_X+ / USB0_X- : USB2.0 OTG Port #0 differential pair

USBC_CC1 / USBC_CC2: Configuration Channels, used to detect cable attachment and removal, receptacle/plug orientation detection, and current advertisement. Signals directly manged by the USB Type-C controller on SBC-C31

USBC0_SBU1 / USBC0_SBU2: Sideband use signals, not used for USB, used as auxiliary channel differential data pair in Display Alternate Mode. Signals directly manged by the USB Type-C controller on SBC-C31

VBUS_C0: Power bus, derived from +5V_ALW power rail, current limited to 1A @5V

USB 3.0 port#1 type-A receptacle - CN10			
Pin	Signal	Pin	Signal
1	$+5V_{USB1}$	5	USB_SSRX1-
2	USB_P1-	6	USB_SSRX1+
3	USB_P1+	7	GND
4	GND	8	USB_SSTX1-
		9	USB_SSTX1+



The USB 3.0 port #1 is available on a single, standard USB 3.0 type-A receptacle, CN10. Since this connector is a standard type of receptacle, it can be connected to all types of USB 1.1 / USB 2.0 / USB 3.0 devices using Standard-A USB 3.0 or USB 2.0 plugs.

For USB 3.0 connections it is mandatory the use of SuperSpeed certified cables, whose SuperSpeed differential pairs are individually shielded inside the global cable's external shielding.

USB_P1+/USB_P1-: USB2.0 OTG Port #1 differential pair

USB_SSTX1+/ USB_SSTX1-: USB Super Speed Port #1 transmit differential pair

USB_SSRX1+/ USB_SSRX1-: USB Super Speed Port #1 receive differential pair

$+5V_{USB1}$ is derived from +5V_ALW power rail with a dedicated 1A current-limited power switch IC.

USB2.0 Host Port#0 is used to manage a quad-port USB Hub, which makes available two additional USB ports on a standard dual Type-A socket, an additional port on internal header and an USB2.0 port used to manage an USB-to-serial bridge used to implement 2x additional UARTs. On the internal USB pin header, it is available USB2.0 Host interface #1, only in case that the module doesn't have the optional LTE module mounted.

USB 2.0 type A Dual receptacle – CN7			
Pin	Signal	Pin	Signal
1	$+5V_{HOST1}$	5	$+5V_{HOST2}$
2	USB_DS_P1-	6	USB_DS_P2-
3	USB_DS_P1+	7	USB_DS_P2+
4	GND	8	GND

Dual USB 2.0 Internal Header – CN8			
Pin	Signal	Pin	Signal
1	$+5V_{HOST3}$	2	$+5V_{HOST4}$
3	USB_DS_P3-	4	USB_Host_1-
5	USB_DS_P3+	6	USB_Host_1+
7	GND	8	GND
		10	---

USB_DS_P1+/ USB_DS_P1-: USB Hub Downstream port #1 differential pair

USB_DS_P2+/ USB_DS_P2-: USB Hub Downstream port #2 differential pair

USB_DS_P3+/ USB_DS_P3-: USB Hub Downstream port #3 differential pair

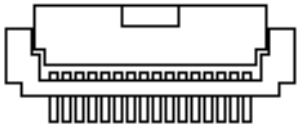
USB_Host_1+/ USB_Host_1-: USB2.0 Host Port #1 differential pair

All USB ports' voltages $+5V_{HOSTx}$ are derived, through a power switch IC, from +5V_ALW voltage. 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.

3.3.8 MIPI-CSI2 Connectors

MIPI-CSI #1 Camera Connector – CN16			
Pin	**Signal**	**Pin**	**Signal**
1	CSI_P1_DN3	10	CSI_P1_DN0
2	CSI_P1_DP3	11	CSI_P1_DP0
3	CSI_P1_DN2	12	GND
4	CSI_P1_DP2	13	MIPI_CSI_EN
5	CSI_P1_DN1	14	N.C.
6	CSI_P1_DP1	15	MIPI_CSI_I2C1_SCL
7	CSI_P1_CKN	16	MIPI_CSI_I2C1_SDA
8	CSI_P1_CKP	17	MIPI_CSI_RST_B
9	GND	18	+3.3V_RUN

MIPI-CSI #2 Camera Connector – CN17			
Pin	**Signal**	**Pin**	**Signal**
1	CSI_P2_DN3	10	CSI_P2_DN0
2	CSI_P2_DP3	11	CSI_P2_DP0
3	CSI_P2_DN2	12	GND
4	CSI_P2_DP2	13	MIPI_CSI_EN
5	CSI_P2_DN1	14	N.C.
6	CSI_P2_DP1	15	MIPI_CSI_I2C4_SCL
7	CSI_P2_CKN	16	MIPI_CSI_I2C4_SDA
8	CSI_P2_CKP	17	MIPI_CSI_RST_B
9	GND	18	+3.3V_RUN



SBC-C31 with RK3399 SoC includes an Image Processing Subsystem, that can be used for video applications, like video-preview, video recording and frame grabbing. For this reason, the SBC-C31 can offer up to two MIPI CSI serial camera interfaces, both supporting up to four differential data lanes.

It is possible to access to the video input ports CN16 and CN17 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.

Signal related to MIPI CSI1 interface:

MIPI_CSI_EN: Camera enable output, active low signal, electrical level +1.8V_RUN

MIPI_CSI_RST_B: Camera Reset output, active low signal, electrical level +1.8V_RUN

MIPI_CSI_I2C1_SCL: I2C Bus clock line. Bidirectional signal, electrical level +1.8V_RUN with a 2K2Ω pull-up resistor. It is managed by the processor's I2C controller #1

MIPI_CSI_I2C1_SDA: I2C Bus data line. Bidirectional signal, electrical level +1.8V_RUN with a 2K2Ω pull-up resistor. It is managed by the processor's I2C controller #1

CSI_P1_DP0/CSI_P1_DN0: MIPI CSI1 Port differential data pair #0

CSI_P1_DP1/CSI_P1_DN1: MIPI CSI1 Port differential data pair #1

CSI_P1_DP2/CSI_P1_DN2: MIPI CSI1 Port differential data pair #2

CSI_P1_DP3/CSI_P1_DN3: MIPI CSI1 Port differential data pair #3

CSI_P1_CKP/ CSI_P1_CKN: MIPI CSI1 Port differential clock pair

Signal related to MIPI CSI2 interface:

MIPI_CSI_EN: Camera enable output, active low signal, electrical level +1.8V_RUN

MIPI_CSI_RST_B: Camera Reset output, active low signal, electrical level +1.8V_RUN

MIPI_CSI_I2C4_SCL: I2C Bus clock line. Bidirectional signal, electrical level +1.8V_RUN with a 2K2Ω pull-up resistor. It is managed by the processor's I2C controller #4

MIPI_CSI_I2C4_SDA: I2C Bus data line. Bidirectional signal, electrical level +1.8V_RUN with a 2K2Ω pull-up resistor. It is managed by the processor's I2C controller #4

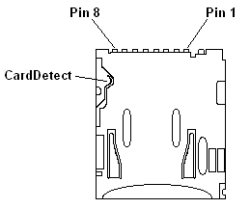
CSI_P2_DP0/CSI_P2_DN0: MIPI CSI2 Port differential data pair #0
CSI_P2_DP1/CSI_P2_DN1: MIPI CSI2 Port differential data pair #1
CSI_P2_DP2/CSI_P2_DN2: MIPI CSI2 Port differential data pair #2
CSI_P2_DP3/CSI_P2_DN3: MIPI CSI2 Port differential data pair #3
CSI_P2_CKP/ CSI_P2_CKN: MIPI CSI2 Port differential clock pair
When connecting CSI cameras to CN16 and CN17 connectors, it is strongly recommended to use shielded cable for EMC compatibility.
At the time being there are functionality limitations so that only MIPI-CSI #1 can be used as well.

3.3.9 microSD Card Slot

microSD Card Slot – CN4	
Pin	**Signal**
1	SD_DATA2
2	SD_DATA3
3	SD_CMD
4	SD_PWR
5	SD_CLK
6	GND
7	SD_DATA0
8	SD_DATA1
CardDetect	SD_CD_B

The RK3399 SoC allows the use of an SDIO interface the implementation of 4-bit SD card.

This SD interface is carried to a standard µSD card slot (CN4), soldered on bottom side of the module, push-push type. The microSD slot is a push-push type, H=1.68 mm, type JST P/N DM3AT-SF-PEJM5 or equivalent.



SD_CD_B: Card Detect Input, indicating when a SDIO/MMC card is present

SD_CLK: SD Clock Line (output).

SD_CMD: Command/Response bidirectional line, used for card initialization and for command transfers

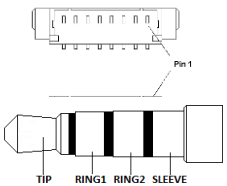
SD_DATA[0÷3]: SD Card data bus. SD_DATA0 signal is used for all communication modes. SD_DATA[1÷3] signals are required for 4-bit communication mode.

SD_PWR voltage is derived from +3.3V_ALW power rail

3.3.10 Audio interface

TRSS Audio Jack – CN12	
Pin	**Signal**
TIP	Headphone Out Left Channel
RING1	Headphone Out Right Channel
RING2	GND
SLEEVE	Mic In

SBC-C31 board integrates a Texas Instrument TLV320 I2S Stereo Audio Codec, for high quality audio implementation.



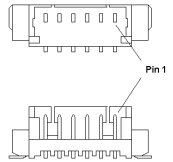
In order to reduce the space dedicated to connectors, there is a TRRS Combo Audio Socket CN12, i.e. a single socket which offer both stereo Line Out and Mic In functionalities.

Such TRRS Combo Audio socket can be used with any 4-poles 3.5mm diameter audio jack, with pinout compatible with the most recent Headsets, shown in the table on the left.

3.3.11 I2C T/S Connector

I2C Touch Connector – CN50	
Pin	**Signal**
1	+3.3V_RUN
2	TOUCH_INT#
3	I2C_SDA
4	I2C_SCL
5	TOUCH_RST
6	GND

SBC-C31 by RK3399 SoC allows the control of a display touch screen by using a dedicated I2C Interface, completed with an Interrupt line and a Reset output.



The dedicated connector is type MOLEX p/n 53398-0671 or equivalent.

Mating connector: MOLEX 51021-0600 receptacle with MOLEX 50079-8000 female crimp terminals.

The functionality is integrated and controlled directly from RK3399 SoC.

The connector CN50 type and his pin-out is shown here.

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.

3.3.12 CAN Connectors

CAN Bus #1 Connector – CN55	
Pin	**Signal**
1	CAN_H_1
2	GND
3	CAN_L_1

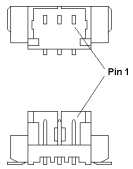
CAN Bus #2 Connector – CN56	
Pin	**Signal**
1	CAN_H_2
2	GND
3	CAN_L_2

Signals Description:

CAN_H_x: High-Level CAN bus line

CAN_L_x: Low-Level CAN bus line

SBC-C31 board can offer up to two CAN Interfaces compliant to CAN specifications rel. 2.0 part B. The transceiver used is designed for high-speed (up to 1Mbps) CAN applications, and also offers improved EMC and ESD performances.

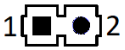


CAN Bus Connectors are 3-pin single line SMT connectors, type MOLEX 53398-0371 or equivalent, with pinout shown in the table on the left.

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

A 120Ω termination resistor can be placed between CAN_H_1 and CAN_L_1 signals. It can be connected or disconnected from the line by using JP2 jumper (Jumper inserted = termination connected).

A 120Ω termination resistor can be placed between CAN_H_2 and CAN_L_2 signals. It can be connected or disconnected from the line by using JP3 jumper (Jumper inserted = termination connected).

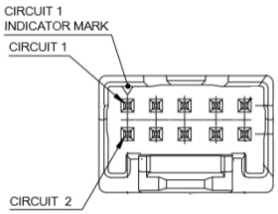


3.3.13 I/O Connectors

I/O Connector #1– CN51	
Pin	**Signal**
1	+3V3_OUT
2	VOUT_EN
3	I2C_SDA_EXT_3V3
4	I2C_SCL_EXT_3V3
5	OUT_Open_Drain
6	OUT1
7	OUT2
8	OUT3
9	OUT4
10	GND

I/O Connector #2– CN52	
Pin	**Signal**
1	+3V3_OUT
2	PWM0_3V3
3	GPIO_OUT3
4	GPIO_OUT1
5	GPIO_OUT2
6	OUT5
7	OUT6
8	OUT7
9	OUT8
10	GND

The SBC-C31 board offers the possibility of expanding its functionalities by using some additional interfaces, available on two dedicated 10 pin connectors CN51 and CN52, type Molex p/n 501645-1020.



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

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

Signal Descriptions:

+3V3_OUT: +3.3V Output Voltage Rail, derived from +3V3_ALW (limited to 1A)

VOUT_EN: Output enable signal, active high signal, +3V3_RUN electrical level.

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 #1

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

PWM0_3V3: Pulse Width Modulated output signal, electrical level +3V3_ALW

OUT_Open_Drain: Open Drain Output Signal, max voltages 12V, max current 205mA

GPIO_OUT1/GPIO_OUT2/GPIO_OUT3: General purpose I/O signals, electrical levels +3V3_RUN. Each one of these signals is filtered using a passive low-pass RC filter (T = 10ns)

OUT1..OUT8: the interfaces available on these pins depends on the factory alternative purchased.

The possible alternative configurations for OUT1..OUT4 are:

- RS-232 ports
- RS-485 ports

The possible alternative configuration for OUT5..OUT8 are:

- RS-232 ports
- RS-485 ports
- 4x GPIOs

This means that there are different possible configurations of these interfaces.

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
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-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-	/	/
NO SERIAL + 4x GPIOs	/	/	/	/	GPIO4	GPIO5	GPIO6	GPIO7
NO SERIAL + RS-232 #2	/	/	/	/	RS232_2_TX	RS232_2_RTS	RS232_2_RX	RS232_2_CTS
NO SERIAL + RS-485 #2	/	/	/	/	RS485_2_D+	RS485_2_D-	/	/

RS-232 / RS-485 port #1 is managed by RK3399 processor's UART interface #3.

RS-232 / RS-485 port #2 is managed by RK3399 processor's UART interface #4.

When the board is configured to have GPIOs 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

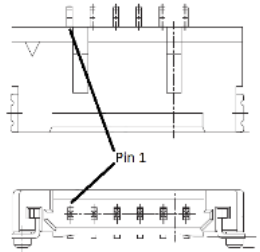
3.3.14 LED Driver Connector

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

SBC-C31 by RK3399 allow the direct control of LCD LED backlights.

The functionality is implemented using an optional 4-Channel WLED controller type MPS MP3385GR-Z driven by I2C interface #2 of RK3399 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

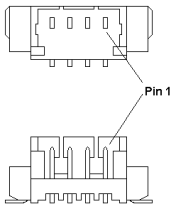
V_LEDx-: LED String x Cathode Input

3.3.15 Serial Ports Connector

A53 Debug UART Connector – CN6	
Pin	**Signal**
1	+3.3V_ALW
2	A53_DUART_RX
3	A53_DUART_TX
4	GND

Onboard, connector CN6 carries out signals related to UART #2 interface from RK3399 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.

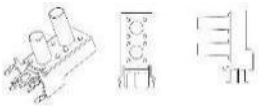


A53_DUART_TX: UART port #2 Transmit signal, +3.3V_ALW electrical level

A53_DUART_RX: UART port #2 Receive signal, +3.3V_ALW electrical level

3.3.16 Power and Reset Header

SC31 board can offer a dual push-button Switch SW1 (P/N HY-1102HLT-A95B50) for the On/Off and System Reset functionalities.

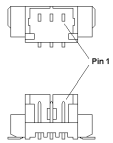


ON/OFF and Reset Connector – CN3	
Pin	**Signal**
1	510Ohm Pull-up to +5V_RUN
2	GND
3	ONOFF
4	GND
5	RST

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.

Independently by the temperature range of the module purchased, it is always available an additional connector, CN3, which can be used to connect remote pushbuttons for System Reset and On/Off functionalities. CN3 is a Molex 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.



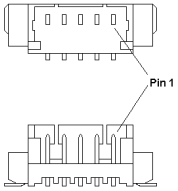
RST: Reset Input, active Low signal. Electrical Level +3.3V_ALW with 1.5kΩ pull-up resistor

ONOFF: Power On/Off Input, active Low signal

3.3.17 SPI Connector

SPI Connector – CN59	
Pin	**Signal**
1	SPI1_MOSI
2	SPI1_MISO
3	SPI_CLK
4	SPI1_CS0#
5	GND

Onboard, connector CN6 carries out signals related to SPI interface #1 from RK3399 processor.



For this purpose, a dedicated 4-pin Connector, Type MOLEX p/n 53398-0571 or equivalent is provided.

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

SPI1_MISO: SPI Master Input Slave Output, input signal, electrical level +3.3V_RUN

SPI1_MOSI: SPI Master Output Slave Input, output signal, electrical level +3.3V_RUN

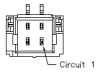
SPI_CLK: SPI Serial Clock, electrical level +3.3V_RUN

SPI1_CS0#: SPI chip select, output signal, active low, electrical level +3.3V_RUN. This signal is activated when this interface is used as communication with external devices

3.3.18 RECOVERY MODE connectors

Two connectors on-board can be used to enter in recovery mode – firmware download mode.

Both connectors are 2-pin, pitch 1mm, type Joint Tech P/N A1001WV-S-2P or equivalent. Mating connector Joint Tech A1001H-2P-1 with Joint Tech A1001-TPE-B female crimp terminals



Maskrom key – CN57	
Pin	**Signal**
1	Maskrom_Key
2	GND

The first connector allows entering in Maskrom Mode

Maskrom is a special internal firmware of RK3399 that runs Rockusb driver automatically when there is no bootable firmware found on on-board storage such as SPI flash, eMMC or microSD card.

The second connector, CN58, allows entering in the firmware download mode.

Recovery mode Key – CN58	
Pin	**Signal**
1	Adkey_IN
2	GND

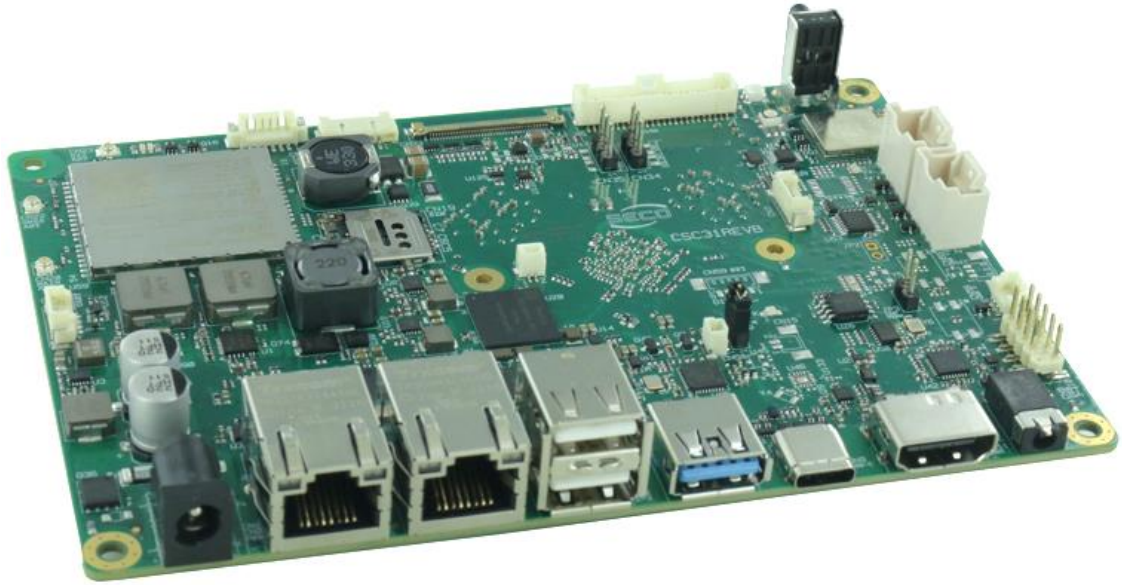
When the key is pressed and the level of ADKEY_IN is kept low at system power-up, RK3399 will enter firmware download mode.

When PC recognizes the USB device, the key is released, then the firmware can be downloaded to the SoC.

This functionality is not supported at the moment and is under development.

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 SBC-C31 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 SBC-C31 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 SBC-C31 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
SC31-DISS-1-PK	SBC-C31 Heat Spreader (PASSIVE)

Warning!

The thermal solutions available with SECO boards are validated and certificated according to IEC 62368-1 in the temperature range [-20°C-85°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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