SBC
User Manual

SBC-D23
Single Board Computer with the Rockchip PX30 SoC on 3.5" form factor

SECO

www.seco.com
REVISION HISTORY

<table>
<thead>
<tr>
<th>Revision</th>
<th>Date</th>
<th>Note</th>
<th>Ref</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>9 November 2021</td>
<td>First Official Release.</td>
<td></td>
</tr>
</tbody>
</table>

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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.
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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/prema (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-D23 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, and wait that the board has already cooled down 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-D23 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 an SBC-D23 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-D23 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-D23 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-D23 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 form 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

<table>
<thead>
<tr>
<th>Term</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>API</td>
<td>Application Program Interface, a set of commands and functions that can be used by programmers for writing software for specific Operating Systems</td>
</tr>
<tr>
<td>CAN Bus</td>
<td>Controller Area network, a protocol designed for in-vehicle communication.</td>
</tr>
<tr>
<td>DDR</td>
<td>Double Data Rate, a typology of memory devices which transfer data both on the rising and on the falling edge of the clock.</td>
</tr>
<tr>
<td>DDR3L</td>
<td>DDR Low Voltage, 3rd Generation</td>
</tr>
<tr>
<td>DVI</td>
<td>Digital Visual Interface, a video-only interface</td>
</tr>
<tr>
<td>FFC/FPC</td>
<td>Flexible Flat Cable / Flat Panel Cable</td>
</tr>
<tr>
<td>Gbps</td>
<td>Gigabits per second</td>
</tr>
<tr>
<td>GND</td>
<td>Ground</td>
</tr>
<tr>
<td>GPIO</td>
<td>General purpose Input/Output</td>
</tr>
<tr>
<td>HDMI</td>
<td>High-Definition Multimedia Interface, an audio and video interface</td>
</tr>
<tr>
<td>I2C Bus</td>
<td>Inter-Integrated Circuit Bus, a simple serial bus consisting only of data and clock line, with multi-master capability</td>
</tr>
<tr>
<td>LVDS</td>
<td>Low Voltage Differential Signaling, a standard for transferring data at very high speed using inexpensive twisted pair copper cables, usually used for video applications</td>
</tr>
<tr>
<td>Mbps</td>
<td>Megabits per second</td>
</tr>
<tr>
<td>MMC/eMMC</td>
<td>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.</td>
</tr>
<tr>
<td>N.A.</td>
<td>Not Applicable</td>
</tr>
<tr>
<td>N.C.</td>
<td>Not Connected</td>
</tr>
<tr>
<td>OpenCL</td>
<td>Open Computing Language, a software library based on C99 programming language, conceived explicitly to realise parallel computing using Graphics Processing Units (GPU)</td>
</tr>
<tr>
<td>OpenVG</td>
<td>Open Vector Graphics, an Open Source API dedicated to hardware accelerated 2D vector graphics</td>
</tr>
<tr>
<td>OS</td>
<td>Operating System</td>
</tr>
<tr>
<td>OTG</td>
<td>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.</td>
</tr>
<tr>
<td>PCI-e</td>
<td>Peripheral Component Interface Express</td>
</tr>
<tr>
<td>PHY</td>
<td>Abbreviation of Physical, it is the device implementing the Physical Layer of ISO/OSI-7 model for communication systems</td>
</tr>
<tr>
<td>PSU</td>
<td>Power Supply Unit</td>
</tr>
<tr>
<td>PWM</td>
<td>Pulse Width Modulation</td>
</tr>
<tr>
<td>Abbreviation</td>
<td>Description</td>
</tr>
<tr>
<td>--------------</td>
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</tr>
<tr>
<td>PWR</td>
<td>Power</td>
</tr>
<tr>
<td>RMII</td>
<td>Reduced Media Independent Interface, a standard interface between the Ethernet Media Access Control (MAC) and the Physical Layer (PHY)</td>
</tr>
<tr>
<td>SD</td>
<td>Secure Digital, a memory card type</td>
</tr>
<tr>
<td>SIM</td>
<td>Subscriber Identity Module, a card which stores all data of the owner necessary to allow him accessing to mobile communication networks</td>
</tr>
<tr>
<td>SM Bus</td>
<td>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</td>
</tr>
<tr>
<td>SPI</td>
<td>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</td>
</tr>
<tr>
<td>TBM</td>
<td>To be measured</td>
</tr>
<tr>
<td>UART</td>
<td>Universal asynchronous receiver transmitter</td>
</tr>
<tr>
<td>USART</td>
<td>Universal Synchronous/asynchronous receiver transmitter</td>
</tr>
<tr>
<td>UIM</td>
<td>User Identity Module, an extension of SIM modules.</td>
</tr>
<tr>
<td>USB</td>
<td>Universal Serial Bus</td>
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</table>
## 1.9 Reference specifications

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

<table>
<thead>
<tr>
<th>Reference</th>
<th>Link</th>
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<tbody>
<tr>
<td>CAN Bus</td>
<td><a href="https://www.iso.org/standard/63648.html">https://www.iso.org/standard/63648.html</a></td>
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<tr>
<td>eDP</td>
<td><a href="http://www.vesa.org">http://www.vesa.org</a></td>
</tr>
<tr>
<td>Fast Ethernet</td>
<td><a href="https://www.ieee802.org/3/">https://www.ieee802.org/3/</a></td>
</tr>
<tr>
<td>HDMI</td>
<td><a href="https://www.hdmi.org/">https://www.hdmi.org/</a></td>
</tr>
<tr>
<td>I2S</td>
<td><a href="https://www.sparkfun.com/datasheets/BreakoutBoards/I2SBUS.pdf">https://www.sparkfun.com/datasheets/BreakoutBoards/I2SBUS.pdf</a></td>
</tr>
<tr>
<td>MMC/eMMC</td>
<td><a href="https://www.jedec.org/committees/k-64">https://www.jedec.org/committees/k-64</a></td>
</tr>
<tr>
<td>OpenGL</td>
<td><a href="http://www.opengl.org">http://www.opengl.org</a></td>
</tr>
<tr>
<td>OpenVG</td>
<td><a href="http://www.khronos.org/opengp">http://www.khronos.org/opengp</a></td>
</tr>
<tr>
<td>SD Card Association</td>
<td><a href="https://www.sdcard.org/home">https://www.sdcard.org/home</a></td>
</tr>
<tr>
<td>SDIO</td>
<td><a href="https://www.sdcard.org/developers/overview/sdio">https://www.sdcard.org/developers/overview/sdio</a></td>
</tr>
<tr>
<td>SM Bus</td>
<td><a href="http://www.smbus.org/specs">http://www.smbus.org/specs</a></td>
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</tbody>
</table>
Chapter 2. OVERVIEW

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

SBC-D23 is a Single Board Computer in 3.5" form factor (which is 146 x 102mm) based on embedded Rockchip PX30 Processor, featuring Quad-Core ARM® Cortex®-A35 processor.

Graphics features of the board are managed directly by the processor, which integrates a Mali-G31 GPU with High performance dedicated 2D processor, supporting OpenGL® ES 1.1 / 2.0 / 3.2, Vulkan 1.0, OpenCL 2.0 and Open VG 1.1.

HW video decoding of the most common coding standard (i.e., MPEG-4, H.265/HEVC, H.264, VP8, VC-1) is supported. Also H.264 encoding (1x1080p@30fps or 2x 720p@30fps) 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 an optional microSD Card slot.

The board can support 24 bit Single Channel LVDS interface.

The processor offers an RMII interface which, through a dedicated Micrel KSZ8091 Ethernet Transceiver, allows the implementation of a FastEthernet interface.

The networking capabilities of this module can be extended through an M.2 Socket 1 Key E slot with UART + SDIO interface, which allows plugging accessory WiFi+BT M.2 modules.

An additional miniPCI-e slot allows expanding the connectivity possibilities of this board. Since this slot is connected to an on-board microSIM slot, it is possible to equip the board with external modem modules.

The SBC-D23 board offers two USB 2.0 standard Type-A connectors; another USB interface can be available, as a factory alternative, on an internal header or on the LVDS connector. The USB OTG interface is available both on a micro-B connector (client mode) and on an additional Type-A connector. Finally, an additional USB header is available, managed by the on-board microcontroller.

The audio functionalities of this board are managed by the Audio Codec embedded in the RK-809 PMIC, which makes available a stereo output on an internal 3-pin connector. Managed as factory alternatives, there can be TRRS combo jack for Headphone and Mic-in or a class-D amplified Stereo output on micro-fit connector.

Many serial ports are available: up to 2x UART/RS-232 (factory alternatives), 1x CAN port, 2x 2-Wire UARTs and 2x 4-Wire UARTs.

SD23 board incorporates HDMI Technology.

Other interfaces available will be thoroughly described in the following chapters.
2.2 Technical specifications

Processors
Rockchip PX30 processor, 4x Cortex®-A35 cores

Memory
Soldered Down DDR3L memory, 32-bit interface, up to 4GB

Graphics
Mail-G31 GPU with High performance dedicated 2D processor
OpenGL ES 1.1 / 2.0 / 3.2, Vulkan 1.0, OpenCL 2.0, DX11 FL9_3
Embedded VPU, able to support:
- Multi-format 1080P 60fps video decoders (H.265, H.264, VC-1, MPEG-4, VP8)
- H.264 1080p@30fps HW encoding
Support 2 independent video outputs

Video Interfaces
LVDS Single Channel interface
HDMI interface

Video Resolution
HDMI, up to 1920x1080
LVDS, up to 1280x800

Mass Storage
Optional eMMC 5.1 Drive soldered on-board, up to 64GB
Optional microSD slot on board

Networking
1x 10/100 Ethernet port
Optional M.2 Socket 1 Key E Slot for WiFi/BT LE external modules
Optional miniPCI-e slot (USB interface only) for external modem modules

USB
3 x USB 2.0 Host ports on standard Type-A slots
USB recovery internal connector

Audio
PMIC embedded Audio Codec
Stereo audio out on internal header

TRRS combo jack for Headphone and Mic In Line Out audio jack or I2S Audio
Class-D amplifier with stereo out available on internal connector (factory alternatives)
Buzzer on-board

Serial ports
1x TTL or RS-232 port (factory alternative)
1x Debug UART
1x TTL or RS-232 port (factory alternatives to microSD slot)
1x RS-485 port on internal connector
1x CAN port

Other Interfaces
miniSIM Slot for USB Modem modules on miniPCI-e form factor
Optional CSI Camera connector
Ultra-low Power RTC
16x GPs @3.3V (5V tolerant)
16x GPOs @3.3V
Trusted Secure Element
4-Channel LED Driver connector

Microcontroller Programmable Interfaces
2x 4-Wire UARTs on internal connector
2x 2-Wire UARTs on internal connector
1x SPI connector
2x I2C on internal connector
8-channel timer connector
16x GPOs + 16x GPs

Power supply voltage: +12Vdc .. +24Vdc

Operating temperature:
- Commercial version 0°C ÷ +60°C **
- Extended Temperature range: -20°C ÷ +85°C **

Dimensions: 142 x 102 mm (3.5" form factor)

Supported Operating Systems: Linux Yocto

** 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

SD23 board can be supplied with any voltage in the range +12V<sub>DC</sub> ÷ +24V<sub>DC</sub> range (recommended voltage range).

This voltage can be supplied through a Right-angle connector type Molex Mini-Fit Jr, p/n 39-30-0040 or equivalent, with the pinout indicated in the table below.

Mating connector: Molex 39-01-2045 or equivalent with 5566 series female crimp terminal.

<table>
<thead>
<tr>
<th>Power In Connector – CN44</th>
<th>Pin</th>
<th>Signal</th>
<th>Pin</th>
<th>Signal</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>GND</td>
<td>3</td>
<td>VIN_SYS</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>GND</td>
<td>4</td>
<td>VIN_SYS</td>
<td></td>
</tr>
</tbody>
</table>

2.3.1 UPS By-pass connector

The SBC-D23 board allow the possibility of connecting external UPS modules able to supply a 12V Backup, to be used in case that the main power supply is not available.

For this kind of connection, it is provided a standard Micro-fit 2x7 connector type Molex 43045-1412 or equivalent, with the pinout shown in the table on the left.

Mating connector: MOLEX 43025-1400 or equivalent with 43030 female crimp terminal.

UPS_BYPASS: UPS power rail enable signal. Used to switch between the power rail coming from the external UPS Module and the standard V<sub>IN</sub> Power Supply. Electrical level +12V<sub>ALW</sub> with 100KΩ pull-up resistor.

UPS_PFO#: Generic Input. It is managed on the SBC-D23 board by I/O Expander B, Port #0 Pin #0. Electrical level +3P3V_RUN.

UPS_INT#: This signal can be used to serve the interrupt request of the UPS device. It is managed on the SBC-D23 board by I/O Expander B, Port #0 Pin #1. Electrical level +3P3V_RUN.

UPS_EN: IO: Generic UPS Enable signal. It is managed on the SBC-D23 board by I/O Expander A, Port #0 Pin #0. Electrical level +3P3V_RUN.

Pin #1. Electrical level +3P3V_RUN.

UPS_BOOST_EN: Generic UPS Enable signal. It is managed on the SBC-D23 board by I/O Expander A, Port #0 Pin #0. Electrical level +3P3V_RUN.
2.3.2 RTC Battery

For the occurrences when the module is not powered with an external power supply, on board there is a battery holder for coin cell Lithium Battery to supply, with a 3V voltage, the Real Time Clock present on-board.

Battery used is a CR2016 Lithium coin-cell battery, with a nominal capacity of 90mAh.

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-D23 are compliant to requirements of European Directive 2006/66/EC regarding batteries and accumulators. When putting out of order SBC-D23, 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.
2.3.3 Power rails

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

V\textsubscript{IN}: Power In voltage (in the range $+12\text{V}_{DC} \ldots +24\text{V}_{DC}$) directly coming from the Power Supply connectors CN44

$+12\text{V}_{ALW}$: $+12\text{V}_{DC}$ power rail, directly generated from $V_{IN}$ power rail, immediately available when $V_{IN}$ voltage is applied. Please be aware that with $V_{IN}$ voltage is between $+12\text{V}_{DC}$ and $+16\text{V}_{DC}$, the $12\text{V}_{ALW}$ will not be equal to $+12\text{V}_{DC}$ but it will be equal to $V_{IN}$ Voltage

$+12\text{V}_{BACKUP}$: external $+12\text{V}_{DC}$ power rail which can be supplied by an UPS Module plugged to connector CN3

$+5\text{V}_{STBY}$: $+5\text{V}_{DC}$ power rail, directly generated from $VIN$ power rail, immediately available when $VIN$ voltage is applied.

$+5\text{V}_{SW}$: main $+5\text{V}_{DC}$ power rail generated by the on-board PMIC from $5V_{STBY}$ power rail.

$+3P3\text{V}_{RUN}$: main $+3.3\text{V}_{DC}$ power rail generated by the on-board PMIC from $5V_{STBY}$ power rail.

$+3P3\text{V}_{SW}$: main $+3.3\text{V}_{DC}$ power rail generated by the on-board PMIC from $+3P3\text{V}_{RUN}$ power rail.

$+3P0V_{VDD}_{PMU}$: generic $+3.0\text{V}_{DC}$ power rail, generated by the on-board PMIC from $+3P3\text{V}_{RUN}$ power rail.

$+1P8V_{VDD}$: generic $+1.8\text{V}_{DC}$ power rail, generated by the on-board PMIC from $+3P3\text{V}_{RUN}$ power rail.

$+3V3\text{MOD}$: $3.3\text{V}_{DC}$ power rail specific for M.2 and miniPCI-e slots, derived from $+12\text{V}_{ALW}$ power rail upon SW enabling.

$+3P3\text{V}_{OUT}_{EC}$: $3.3\text{V}$ power rail specific for the I/O connectors managed by the microcontroller, derived from $+3P3\text{V}_{SW}$ power rail upon SW enabling.

$+1P5V_{PCIE}$: $+1.5\text{V}_{DC}$ power rail dedicated to the miniPCI-e slot, derived automatically from $+3P3\text{V}_{SW}$ power rail

$VCC_{uSD}$: dedicated $+3.3\text{V}_{DC}$ power rail for microSD slot, generated by the on-board PMIC from $+3P3\text{V}_{RUN}$ power rail.

$VDD\_TOUCH$: dedicated $+5\text{V}_{DC}$ power rail for external USB or I2C T/S controller, generated from the $+5V_{STBY}$ Power rail once the $+3P3\text{V}_{RUN}$ power rail is steady.
## 2.3.4 Power consumption

The power consumption has been measured on V\textsubscript{IN} power rail using a 24V\textsubscript{DC} source. Power consumption measurement is performed with DC Power Analyzer Keysight and must be intended as average value (30 seconds acquisition). For peak measurement please refer to following Values, acquired with DC Power Analyzer Keysight.

For measurement, the following configuration has been considered.

Processor: PX30 Commercial temperature range;
RAM: 2GB DDR3L;
Storage: 4GB eMMC;
Video Interface: LVDS + HDMI;
Networking: 1x FastEthernet LAN + Modem module QUECTEL EG25GGB-MINIPCIE + WiFi module Azurwave AW-CM390MA;
Audio: Power Amplifier mounted
Other: no microSD Slot, UART #B RS-232 mode
Commercial Temperature range

8.0" LVDS Display 1024x600 connected

<table>
<thead>
<tr>
<th>Status</th>
<th>Configuration #1</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Average Value (30s)</td>
<td>Peak Value</td>
<td></td>
</tr>
<tr>
<td>U-Boot Idle (Linux)</td>
<td>4.8W</td>
<td>0.200A</td>
<td>3.7W</td>
</tr>
<tr>
<td>Boot (Linux)</td>
<td>7.51W</td>
<td>0.313A</td>
<td></td>
</tr>
<tr>
<td>Idle (Linux)</td>
<td>5.04W</td>
<td>0.210A</td>
<td>5.28W</td>
</tr>
<tr>
<td>Test Storage Device (3 x USB)</td>
<td>8.09W</td>
<td>0.337A</td>
<td></td>
</tr>
<tr>
<td>CPU 100% + GPU 100% + LTE + Wi-Fi</td>
<td>10.97W</td>
<td>0.457A</td>
<td>18.7W</td>
</tr>
</tbody>
</table>
2.4 Mechanical specifications

According to 3.5° form factor, board dimensions are: 147 x 101.6 mm (5.79" x 4.0").
The printed circuit of the board is made of ten layers, some of them are ground planes, for disturbance rejection.
2.5 Block diagram

[Block diagram image showing various components and their connections, including:
- Trusted Secure Element
- 2x I/O Expander
- EEPROM
- Ultra Low Power RTC
- RJ-45
- RS-232 Connector
- microSD Slot
- RS-232 Connector
- Debug UART
- M.2 Key E Slot
- Buzzer
- Touch Screen
- CAN
- RS485 Ext
- Dual 4-wire UART Conn.
- Dual 2-wire UART Conn.
- SPI Connector
- Dual I2C Connector
- 8-Channel Timer
- 16 GPI Connector
- 16 GPO Connector
- USB Client Header
- Coin Cell Battery Holder
- Memory
- Opt. Class-D Audio Amplifier
- Headphone Mic In
- RGB to HDMI bridge
- Camera Connector
- miniPCI-e Slot
- microSIM Slot
- USB Type-A Connector
- T/S connector
- LVDS
- VLED Connector
- USB recovery connector
- Speaker Out
- Amplif. Stereo Speaker Out
- RGB
- RAM
- PMIC – Audio Amplifier
- USB_HOST
- STM32F302VCT6
- ROCKCHIP PX30
- LED Driver
- USB Hub
- SPI0
- I2C0
- I2C1
- I2C2
- SDIO0/UART4
- UART0
- UART1
- UART2
- UART3
- SDIO
- PWM2
- I2S
- SPI
- Dual I2C
- 16 GPI
- 16 GPO
- USB Client Header
- Coin Cell
- Battery Holder
- SSR
- 8-bit Timer
- USB_OTG
- Coin Cell Battery Holder
- EEPROM
- Trusted Secure Element
- 2x I/O Expander
- EEPROM
- Ultra Low Power RTC
- RJ-45
- RS-232 Connector
- microSD Slot
- RS-232 Connector
- Debug UART
- M.2 Key E Slot
- Buzzer
- Touch Screen
- CAN
- RS485 Ext
- Dual 4-wire UART Conn.
- Dual 2-wire UART Conn.
- SPI Connector
- Dual I2C Connector
- 8-Channel Timer
- 16 GPI Connector
- 16 GPO Connector
- USB Client Header
- Coin Cell Battery Holder
- Memory
- Opt. Class-D Audio Amplifier
- Headphone Mic In
- RGB to HDMI bridge
- Camera Connector
- miniPCI-e Slot
- microSIM Slot
- USB Type-A Connector
- T/S connector
- LVDS
- VLED Connector
- USB recovery connector
- Speaker Out
- Amplif. Stereo Speaker Out
- RGB
- RAM
- PMIC – Audio Amplifier
- USB_HOST
- STM32F302VCT6
- ROCKCHIP PX30
- LED Driver
- USB Hub
- SPI0
- I2C0
- I2C1
- I2C2
- SDIO0/UART4
- UART0
- UART1
- UART2
- UART3
- SDIO
- PWM2
- I2S
- SPI
- Dual I2C
- 16 GPI
- 16 GPO
- USB Client Header
- Coin Cell
- Battery Holder
- SSR
- 8-bit Timer
- USB_OTG
]
Chapter 3.
CONNECTORS

- Introduction
- Connectors’ overview
- Connectors’ description
3.1 Introduction

On SBC-D23 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.
### 3.2 Connectors’ overview

#### 3.2.1 Connector List

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CN3</td>
<td>UPS Bypass</td>
<td>CN29</td>
<td>CAN Connector #1</td>
</tr>
<tr>
<td>CN4</td>
<td>CSI Camera connector</td>
<td>CN30</td>
<td>CAN Connector #2</td>
</tr>
<tr>
<td>CN5</td>
<td>10/100 RJ-45 Ethernet connector</td>
<td>CN31</td>
<td>STM32 USB client header</td>
</tr>
<tr>
<td>CN6</td>
<td>Dual USB Type-A slot</td>
<td>CN32</td>
<td>STM32 Dual 2-Wire UART Connector</td>
</tr>
<tr>
<td>CN7</td>
<td>USB recovery connector</td>
<td>CN33</td>
<td>STM32 Dual I2C Connector</td>
</tr>
<tr>
<td>CN8</td>
<td>USB Type-A slot</td>
<td>CN34</td>
<td>STM32 8-Channel timer connector</td>
</tr>
<tr>
<td>CN9</td>
<td>LVDS + I2C T/S Connector</td>
<td>CN39</td>
<td>STM32 SPI Connector</td>
</tr>
<tr>
<td>CN13</td>
<td>USB T/S connector</td>
<td>CN42</td>
<td>RS-232 / UART #A connector</td>
</tr>
<tr>
<td>CN14</td>
<td>HDMI Connector</td>
<td>CN43</td>
<td>RS-232 / UART #B connector</td>
</tr>
<tr>
<td>CN15</td>
<td>M.2 Key E Slot</td>
<td>CN44</td>
<td>Power In connector</td>
</tr>
<tr>
<td>CN17</td>
<td>minPCI-e slot</td>
<td>CN47</td>
<td>Speaker out connector</td>
</tr>
<tr>
<td>CN18</td>
<td>microSIM Slot</td>
<td>CN48</td>
<td>RS-485 Connector</td>
</tr>
<tr>
<td>CN20</td>
<td>LED Driver connector</td>
<td>CN49</td>
<td>STM32 16xGPI Connector</td>
</tr>
<tr>
<td>CN24</td>
<td>TRRS Audio jack</td>
<td>CN50</td>
<td>STM32 16x GPOs Connector</td>
</tr>
<tr>
<td>CN25</td>
<td>microSD Slot</td>
<td>CN55</td>
<td>Amplified Stereo speaker connector</td>
</tr>
<tr>
<td>CN26</td>
<td>Battery holder</td>
<td>CN56</td>
<td>STM32 programming</td>
</tr>
<tr>
<td>CN27</td>
<td>Debug UART connector</td>
<td>J2</td>
<td>STM32 Dual 4-Wire UART Connector</td>
</tr>
</tbody>
</table>

#### 3.2.2 Jumpers List

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CN10</td>
<td>LCD Power selector</td>
<td>J P2</td>
<td>CAN Bus Termination</td>
</tr>
<tr>
<td>CN12</td>
<td>Backlight Power selector</td>
<td>J P3</td>
<td>RS-485 Bus Termination</td>
</tr>
</tbody>
</table>
3.3 Connectors’ description

3.3.1 10/100 Ethernet connector

On board, there is a FastEthernet interface, made available by a Micrel KSZ8091RBA 10Baset-T/100Base-Tx Transceiver interfaced to PX30 RMII interface.

The connector is type TRXCOM p/n TRJ19401BGNL or equivalent, with 2kV decoupling capacitor.

This interface is compatible only with Fast Ethernet (10/100Mbps) Networks. When connected to Gigabit Ethernet Networks, the speed will be limited to 100Mbps.

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 connector there are also two LEDs. Left LED is Yellow and shows 10/100 connection. The right LED blinks Green to show ACTIVITY presence.

ETH_Tx+/ ETH_Tx-: Ethernet Transmit differential pair.

ETH_Rx+/ ETH_Rx-: Ethernet Receive differential pair.

<table>
<thead>
<tr>
<th>Pin</th>
<th>Signal</th>
<th>Pin</th>
<th>Signal</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>ETH_Tx+</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>ETH_Tx-</td>
<td>6</td>
<td>ETH_Rx-</td>
</tr>
<tr>
<td>3</td>
<td>ETH_Rx+</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>8</td>
<td></td>
</tr>
</tbody>
</table>

**10/100 Ethernet Port – CN5**
3.3.2 M.2 2230 Socket 1 Key E Connectivity Slot

It is possible to increase the connectivity of the SBC-D23 board by using M.2 Socket 1 Key E connectivity slot.

The connector used for the M.2 Connectivity slot is CN36, which is a standard 75 pin M.2 Key E connector, type LOTES p/n APCI0095-P001A, H=8.5mm, with the pinout shown in the table on the left.

On the SBC-D23 board there is also a Threaded Spacer which allows the placement of M.2 Socket 1 Key E connectivity modules in 2230/3030 size.

This slot only supports M.2 Socket 1 Key E modules using SDIO and UART interfaces; it doesn’t support modules requiring PCI-e and/or USB interfaces.

<table>
<thead>
<tr>
<th>Pin</th>
<th>Signal</th>
<th>Pin</th>
<th>Signal</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>GND</td>
<td>2</td>
<td>+3V3_MOD</td>
</tr>
<tr>
<td>3</td>
<td>---</td>
<td>4</td>
<td>+3V3_MOD</td>
</tr>
<tr>
<td>5</td>
<td>---</td>
<td>6</td>
<td>LED1#</td>
</tr>
<tr>
<td>7</td>
<td>GND</td>
<td>8</td>
<td>---</td>
</tr>
<tr>
<td>9</td>
<td>SDIO CLK</td>
<td>10</td>
<td>---</td>
</tr>
<tr>
<td>11</td>
<td>SDIO_CMD</td>
<td>12</td>
<td>---</td>
</tr>
<tr>
<td>13</td>
<td>SDIO_DAT0</td>
<td>14</td>
<td>---</td>
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<tr>
<td>15</td>
<td>SDIO_DAT1</td>
<td>16</td>
<td>LED2#</td>
</tr>
<tr>
<td>17</td>
<td>SDIO_DAT2</td>
<td>18</td>
<td>+3V3_MOD</td>
</tr>
<tr>
<td>19</td>
<td>SDIO_DAT3</td>
<td>20</td>
<td>UART_WAKE#</td>
</tr>
<tr>
<td>21</td>
<td>SDIO_WAKE#</td>
<td>22</td>
<td>UART_RXD</td>
</tr>
<tr>
<td>23</td>
<td>SDIO_RESET#</td>
<td>32</td>
<td>UART_TXD</td>
</tr>
<tr>
<td>33</td>
<td>GND</td>
<td>34</td>
<td>UART_CTS</td>
</tr>
<tr>
<td>35</td>
<td>---</td>
<td>36</td>
<td>UART_RTS</td>
</tr>
<tr>
<td>37</td>
<td>---</td>
<td>38</td>
<td>---</td>
</tr>
<tr>
<td>39</td>
<td>GND</td>
<td>40</td>
<td>---</td>
</tr>
<tr>
<td>41</td>
<td>---</td>
<td>42</td>
<td>---</td>
</tr>
<tr>
<td>43</td>
<td>---</td>
<td>44</td>
<td>---</td>
</tr>
<tr>
<td>45</td>
<td>GND</td>
<td>46</td>
<td>---</td>
</tr>
<tr>
<td>47</td>
<td>---</td>
<td>48</td>
<td>---</td>
</tr>
<tr>
<td>49</td>
<td>---</td>
<td>50</td>
<td>SUSCLK</td>
</tr>
</tbody>
</table>

Here following the description of the signals available on this slot

SDIO_CLK: PX30 SDIO interface Clock Line, +1P8V_VDD electrical level Output
SDIO_CMD: PX30 SDIO Command/Response, +1P8V_VDD electrical level bidirectional line.
SDIO_DAT[0..3]: PX30 SDIO Data bus, +1P8V_VDD electrical level bidirectional lines.

SDIO_WAKE#: SDIO Sideband Wake Signal Input, active Low.

SDIO_RESET#: SDIO Sideband Reset Signal output, active Low, electrical level +1P8V_RUN.

LED1#: Active Low signal, can be used by the module to drive a Red LED available on D23 board, specific for M.2 Key E Slot functionalities

LED2#: Active Low signal, can be used by the module to drive a Blue LED available on D23 board, specific for M.2 Key E Slot functionalities

UART_WAKE#: UART Sideband Wake Signal Input, used to wake up the platform.

UART_RXD: PX30 UART port #1 Receive signal, +1P8V_VDD electrical level

UART_TXD: PX30 UART port #1 Transmit signal, +1P8V_VDD electrical level

UART_CTS: PX30 UART port #1 Clear To Send signal, +1P8V_VDD electrical level

UART_RTS: PX30 UART port #1 Request To Send signal, +1P8V_VDD electrical level

SUS_CLK: Suspend Clock, 32.768kHz clock supply output provided by the Platform to the adapter in order to let it to implement the reduced power consumption modes. Electrical level +3P0V_VDD_PMU with 10kΩ pull-up resistor

M2_DISABLE1#, M2_DISABLE2#: M.2 Module’s generic disable signals, managed on the SBC-D23 board by two GPIOs of the on-board I/O Expanders. Electrical level +3P3V_SW.
3.3.3 miniPCI-e WWAN Slot

To add communications functionality, or other features not already available, it is possible to use Half-/ Full-size mini-PCI Express cards, using the dedicate connector, CN17, which is a standard 52pin miniPCIExpress connector, type LOTES AAA-PCI-047-K01 or equivalent, H=9.0mm, with the pinout shown in the table on the left.

SBC-D23 board allows inserting only modules in Half-mini form factor.

On the slot are also available the signals for interfacing to microSIM cards, so that it is possible to use miniPCI Express card modems requiring USB Only interface (PCI-e interface is not available on this slot).

Signals carried to miniPCI-express slot are the following:

mPCI_E_WAKE#: Board's Wake Input, it must be externally driven by the module inserted in the slot when it requires waking up the system.

mPCI_E_W_DISABLE#: Wireless Disable signal, managed on the SBC-D23 board by one GPIO of the on-board I/O Expanders. Electrical level +3P3V_SW.

mPCI_E_RST#: Reset Signal, managed on the SBC-D23 board by one GPIO of the on-board I/O Expanders. Electrical level +3P3V_SW.

USBHUB_P1+/USBHUB_P1: USB Hub Downstream Port #1, differential pair

UIM_RST#: Reset signal line, sent from the modem module to the microSIM card.

UIM_DATA: Bidirectional Data line between the modem module and the microSIM card.

UIM_CLK: Clock line, output from the modem module to the microSIM card.

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

Please be aware that all signals related to User Identity Modules are managed directly by the miniPCI-express card circuitry, they don't involve SBC-D23 board's management. The SBC_D23 board embeds only clamping diodes for ESD protection on UIM signal and voltage lines.

Three SMT RED LEDs are present near this Mini PCI-Express Card Slot to show the presence
of an eventual Wi-Fi PCI-Express Card inserted in the slot. These LEDs can work only if the Wi-Fi Mini PCI Express Card you are using supports and drives them opportunistically through the signals LED_WPAN#, LED_WLAN# and LED_WWAN#.

Blue LED D35: Wireless_PAN present (Bluetooth)
Red LED D36: Wireless_LAN present (for wireless networks)
Green LED D37: Wireless_WAN present (for cellular data, like GSM/GPRS/UMTS)

### 3.3.4 microSIM Card Slot

Interfaced to the miniPCI-e slot CN17, there is a microSIM Card Slot, to be used in conjunction with M.2 Socket 2 Key B modems. Here it is possible to insert the microSIM card provided by any telecommunication operator for the connection to their network.

The socket is type TE p/n 2822541-1 or equivalent, with the pinout shown in the table on the left. Signal are described in the above paragraph.

The signals here available are described in the previous paragraph.

### 3.3.5 microSD Slot

The PX30 SoCs embeds an SD/MMC controller able to support SD/MMC Cards.

On SBC-D23 board, this controller can manage an optional microSD Card Slot for the use of standard microSD cards, which can be used as Mass Storage and/or Boot Devices.

Please be aware that Hot Plug of the SD card is not supported, it must be plugged before board’s boot.

The connector is a microSD connector, push-push type, H=2mm, p/n TFWF1.

SD_CLK: SD Clock Line (output).
SD_CMD: Command/Response bidirectional line.
SD_DAT[0÷3]: SD Card data bus. SD_DAT0 signal is used for all communication modes. SD_DAT[1÷3] signals are required for 4-bit communication mode.

microSD Card slot is offered as a factory alternative to RS-232 or TTL COM Port #B available on connector CN43. Please check also par. 3.3.13.
3.3.6 LVDS connector

SD23 can be interfaced to LCD displays using its LVDS interface, which allows connecting 18 or 24 bit single channel displays. This interface is native of the PX30 Processor, with a maximum supported resolution of 1280x800 @ 60fps.

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


On the same connector are also implemented the signals for direct driving of display’s backlight: voltages (VCC_LCD_SW and VCC_BKL_SW) and control signals (LCD enable signal, PANEL_ON, Backlight enable signal, BKL_EN, and Backlight Brightness Control signal with pulse width modulation, DISPLAY_BKL_CTRL).

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

Through the same connector, it is also possible to connect to display’s LED driver interface, using three dedicated signals (V_LED+, V_LED1-, V_LED2-), which are also available on the dedicated LED Driver connector CN20. Please refer to paragraph 3.3.7 for a description of these 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 differential data pair #0.
LVDS_0_TX1+/LVDS_0_TX1-: LVDS Channel differential data pair #1.
LVDS_0_TX2+/LVDS_0_TX2-: LVDS Channel differential data pair #2.
LVDS_0_TX3+/LVDS_0_TX3-: LVDS Channel differential data pair #3.
LVDS_0_CLK+/LVDS_0_CLK-: LVDS Channel differential Clock.

LVDS_DDC_SDA: DisplayID I2C Data line for LVDS flat Panel detection or for the management of an I2C Touch Screen Controller. Bidirectional signal, electrical level +3P0V_VDD_PMU with a 2kΩ pull-up resistor.

LVDS_DDC_SCL: DisplayID I2C Clock line for LVDS flat Panel detection or for the management of an I2C Touch Screen Controller. Bidirectional signal, electrical level +3P0V_VDD_PMU with a 2kΩ pull-up resistor.
**BKL_EN**: +3P3V_SW electrical level Output with 50kΩ pull-down resistor, Backlight Enable signal. It can be used to turn On/Off the backlight’s lamps of connected displays.

**Panel On**: +3P3V_SW electrical level Output with 100kΩ pull-down resistor, Panel Power Enable signal. It can be used to turn On/Off the connected display.

**DISPLAY_BKL_CTRL**: this signal can be used to adjust the backlight brightness in displays supporting Pulse Width Modulated (PWM) regulations (+3P0V_VDD_PMU electrical level with 100kΩ pull-down resistor).

**TOUCH_RST#**: This signal can be used to drive a reset of an eventual external Touch Screen connected to the dedicated I2C interface. It is managed on the SBC-D23 board by one GPIO of the on-board I/O Expanders. Electrical level +3P3V_SW.

**TOUCH_INT#**: This signal can be used to serve the interrupt request of an eventual external Touch Screen connected to the dedicated I2C interface. It is managed on the SBC-D23 board by one GPIO of the on-board I/O Expanders. Electrical level +3P3V_SW with a 10kΩ pull-down resistor

<table>
<thead>
<tr>
<th>CN10 position</th>
<th>LCD Power selector</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-2</td>
<td>+3.3V</td>
</tr>
<tr>
<td>2-3</td>
<td>+5V</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CN12 position</th>
<th>Backlight Power selector</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-2</td>
<td>+5V</td>
</tr>
<tr>
<td>2-3</td>
<td>+12V</td>
</tr>
</tbody>
</table>

**VCC_LCD_SW**: LCD switched voltage rail. Its value can be set to +3P3V_SW or +5V_STBY by using dedicated jumper CN10, which is a standard pin header, P2.54mm, 1x3 pin.

**VCC_BKL_SW**: Backlight switched voltage rail. Its value can be set to +5V_STBY or +12V_ALW by using dedicated jumper CN12, same type of CN10.

Please be aware that with VIN voltages between +12V and +16VDC, the VCC_BKL_SW will not be equal to +12VDC but it will be equal to VIN Voltage.

Since the use of jumpers in environments with vibrations issues could be a problem, it is possible to provide SD23 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.

### 3.3.7 LED Driver Connector

SD23 board also allow the connection of LVDS Displays requiring a dedicated LED Driver.

The functionality is implemented using a 4-Channel WLED controller type MPS MP3385GR.

Through this connector, it is possible to connect up to 4 LED strings requiring a max of 90mA 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

### 3.3.8 Touch Screen Connector

**Touch Screen connector – CN13**

<table>
<thead>
<tr>
<th>Pin</th>
<th>Signal</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>VDD_TOUCH</td>
</tr>
<tr>
<td>2</td>
<td>USBHUB_P4</td>
</tr>
<tr>
<td>3</td>
<td>USBHUB_P4+</td>
</tr>
<tr>
<td>4</td>
<td>TOUCH_INT#</td>
</tr>
<tr>
<td>5</td>
<td>TOUCH_RST#</td>
</tr>
<tr>
<td>6</td>
<td>GND</td>
</tr>
</tbody>
</table>

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

TOUCH_INT# and TOUCH_RST# signals available on this connector are exactly the same available on LVDS connector CN40. Please look at par. 3.3.6. for their description.

USBHUB_P4+/USBHUB_P4-: USB Hub Downstream Port #4, differential pair

As an alternative, the USB interface on pins #3 and #4 can be replaced by an I2C interface. Please contact your sales rep for more details about this possibility.

### 3.3.9 HDMI connector

**HDMI Connector – CN14**

<table>
<thead>
<tr>
<th>Pin</th>
<th>Signal</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>TMDS_LANE2+</td>
</tr>
<tr>
<td>2</td>
<td>GND</td>
</tr>
<tr>
<td>3</td>
<td>TMDS_LANE2-</td>
</tr>
<tr>
<td>4</td>
<td>TMDS_LANE1+</td>
</tr>
<tr>
<td>5</td>
<td>GND</td>
</tr>
<tr>
<td>6</td>
<td>GND</td>
</tr>
<tr>
<td>7</td>
<td>TMDS_LANE0+</td>
</tr>
<tr>
<td>8</td>
<td>GND</td>
</tr>
<tr>
<td>9</td>
<td>TMDS_LANE0-</td>
</tr>
<tr>
<td>10</td>
<td>TMDS_CLK+</td>
</tr>
<tr>
<td>11</td>
<td>GND</td>
</tr>
<tr>
<td>12</td>
<td>TMDS_CLK-</td>
</tr>
<tr>
<td>13</td>
<td>CEC</td>
</tr>
<tr>
<td>14</td>
<td>GND</td>
</tr>
<tr>
<td>15</td>
<td>SCL</td>
</tr>
<tr>
<td>16</td>
<td>SDA</td>
</tr>
<tr>
<td>17</td>
<td>GND</td>
</tr>
<tr>
<td>18</td>
<td>+5V_HDMI</td>
</tr>
<tr>
<td>19</td>
<td>HPD</td>
</tr>
</tbody>
</table>

The Rockchip PX30 SoCs offers, for video output, also a parallel RGB, supporting up to 1920x1080 video resolution.

To make this interface suitable for the connection of common table-top displays, on SBC-D23 board there is an NXP TDA19988 HDMI1.4a transmitter.

Therefore, on-board it is available a standard certified HDMI connector, upright, type A, WINWIN P/N WHDR-19D1BBNU3N.

Signals involved in HDMI management are the following:

<table>
<thead>
<tr>
<th>Signal</th>
</tr>
</thead>
<tbody>
<tr>
<td>TMDS_CLK+/TMDS_CLK-: TMDS differential Clock.</td>
</tr>
<tr>
<td>TMDS_LANE0+/TMDS_LANE0-: TMDS differential pair #0</td>
</tr>
<tr>
<td>TMDS_LANE1+/TMDS_LANE1-: TMDS differential pair #1</td>
</tr>
<tr>
<td>TMDS_LANE2+/TMDS_LANE2-: TMDS differential pair #2</td>
</tr>
</tbody>
</table>

SDA: DDC Data line for HDMI panel. Bidirectional signal, electrical level +5V_HDMI with a 10kΩ pull-up resistor.

SCL: DDC Clock line for HDMI panel. Output signal, electrical level +5V_HDMI with a 10kΩ pull-up resistor.

CEC: HDMI Consumer Electronics Control (CEC) Line. Bidirectional signal, electrical level +3.3V_SW with a 27kΩ pull-up resistor and Schottky Diode.
HPD: Hot Plug Detect input signal. +5V_HDMI electrical level signal.
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.
Please be aware that only HDMI displays are fully supported through connector CN14. DVI displays, although having a similar TMDS interface, are not supported.

3.3.10 Optional MIPI-CI2 Connector

The Rockchip PX30 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 OMRON p/n XF2M-1815-1A which is able to accept 18 poles 0.5mm pitch FFC cables.

CSI_PWDN#: Camera enable output, active low signal, electrical level +3P3V_SW
CSI_RST#: Camera Reset output, active low signal, electrical level +3P3V_SW
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.

When connecting CSI cameras to CN4 connector, it is strongly recommended to use shielded cable for EMC compatibility.
3.3.11 USB Connectors

The PX30 processor offers an USB 2.0 Host and an USB 2.0 OTG interface.

### USB recovery connector – CN7

<table>
<thead>
<tr>
<th>Pin</th>
<th>Signal</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>VBUS_RECOVERY</td>
</tr>
<tr>
<td>2</td>
<td>USB_OTG_C1-</td>
</tr>
<tr>
<td>3</td>
<td>USB_OTG_C1+</td>
</tr>
<tr>
<td>4</td>
<td>GND</td>
</tr>
</tbody>
</table>

The USB OTG interface is switched between an internal header (CN7, reserved for recovery purposes), and an USB Type-A slot (included in the Dual USB Type-A Slot CN6).

CN7 is a 1.25mm pitch connector type Molex p/n 53398-0471 or equivalent.

Mating connector: MOLEX 51021-0400 receptacle with MOLEX 50079-8000 female crimp terminals.

USB_OTG_C1+/USB_OTG_C1-: USB OTG Port #1 (client mode) differential pair.

On this connector, only client functionality is supported. When an external Host is connected, the presence of an external 5V voltage on pin #1 (i.e. VBUS_RECOVERY) automatically switch the OTG Port to CN7.

The USB 2.0 Host interface, instead, is carried to a Microchip USB2514 USB2.0 Hub, which makes available four USB 2.0 downstream host ports.

The USB Downstream port #1 is carried to miniPCIe- slot CN17 (see par. 3.3.3).

### USB Type-A Slot – CN8

<table>
<thead>
<tr>
<th>Pin</th>
<th>Signal</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>+5V</td>
</tr>
<tr>
<td>2</td>
<td>USB_D2-</td>
</tr>
<tr>
<td>3</td>
<td>USB_D2+</td>
</tr>
<tr>
<td>4</td>
<td>GND</td>
</tr>
</tbody>
</table>

The USB downstream port #2 is carried to connector CN8, which is a standard USB Type A socket, shielded, upright.

USB_D2+/USB_D2-: USB Hub Downstream port #2 differential pair.

### Dual USB 2.0 Type-A Socket – CN6

<table>
<thead>
<tr>
<th>Pin</th>
<th>Signal</th>
<th>Pin</th>
<th>Signal</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>+5V_USB3</td>
<td>5</td>
<td>+5V_USB1</td>
</tr>
<tr>
<td>2</td>
<td>USB_D3-</td>
<td>6</td>
<td>USB_OTG_H1-</td>
</tr>
<tr>
<td>3</td>
<td>USB_D3+</td>
<td>7</td>
<td>USB_OTG_H1+</td>
</tr>
<tr>
<td>4</td>
<td>GND</td>
<td>8</td>
<td>GND</td>
</tr>
</tbody>
</table>

The USB downstream port #3 is carried to a double connector, CN6, which is a standard double USB Type A socket, shielded. The other port available on this connector is the USB OTG Port previously described, available only when the recovery mode is not active (i.e. there isn’t an USB Host connected to CN7).

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.

USB_D3+/USB_D3-: USB Hub Downstream port #3 differential pair.

USB_OTG_H1+/USB_OTG_H1-: USB OTG Port #1 (Host mode) differential pair.

The USB Downstream port #4 is connected to the T/S connector CN13 (see par. 3.3.8).
The board can offer an additional USB Client interface, managed by the STM32F302 microcontroller. This is available on CN31, which is a 1.25mm pitch connector type Molex p/n 53398-0471 or equivalent. Mating connector: MOLEX 51021-0400 receptacle with MOLEX 50079-8000 female crimp terminals. STM32_USB_D+ / STM32_USB_D-: STM32 USB Controlled Port #1 differential pair.

### STM32 USB connector – CN31

<table>
<thead>
<tr>
<th>Pin</th>
<th>Signal</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>+5V_USB_EC</td>
</tr>
<tr>
<td>2</td>
<td>STM32_USB_D-</td>
</tr>
<tr>
<td>3</td>
<td>STM32_USB_D+</td>
</tr>
<tr>
<td>4</td>
<td>GND</td>
</tr>
</tbody>
</table>

All USB ports’ voltages (+5V_USBx and +5V_USB_EC) are derived, through a power switch IC, from +5V_STBY voltages.

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.
3.3.12 Audio Connectors

**TRRS Audio Jack – CN24**

<table>
<thead>
<tr>
<th>Pin</th>
<th>Signal</th>
</tr>
</thead>
<tbody>
<tr>
<td>TIP</td>
<td>Headphone Out Left Channel</td>
</tr>
<tr>
<td>RING1</td>
<td>Headphone Out Right Channel</td>
</tr>
<tr>
<td>RING2</td>
<td>GND</td>
</tr>
<tr>
<td>SLEEVE</td>
<td>Mic In</td>
</tr>
</tbody>
</table>

On SBC-D23 board, audio functionalities are offered directly by the RK809 PMIC, which embeds a high performance Audio Codec.

Always available on all factory configurations of SBC-D23 board, there is a TRRS Combo Audio Socket CN24, 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.

Always available, there is also a dedicated 3-pin connector, type 53398-0371, for the connection of external speakers (earphones)

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

SPKR_OUT+: Amplified speaker Positive Output
SPKR_OUT-: Amplified speaker Negative Output

**Speaker Connector – CN47**

<table>
<thead>
<tr>
<th>Pin</th>
<th>Signal</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>SPKR_OUT+</td>
</tr>
<tr>
<td>2</td>
<td>GND</td>
</tr>
<tr>
<td>3</td>
<td>SPKR_OUT-</td>
</tr>
</tbody>
</table>

As a factory option, the SBC-D23 board can be supplied with a TI TPA3110D2 Class-D amplifier, offering stereo speaker output on a Micro-fit 2x2 connector type Molex 43045-0424 or equivalent, as shown in the figure.

Mating connector: MOLEX 43025-0400 or equivalent with 43030 female crimp terminal

The power output available on this connector is dependent on the value of \( V_{IN} \) Power rail. When the board is powered with a 24V voltage, it can reach up to 15W per channel on 8Ohm load @ 10% Total Harmonic Distortion + Noise (THD+N)

Please be aware that the optional audio amplifier will exclude the headphone out (right and left) on TRRS connector, since this interface is needed as an input to the amplifier.
3.3.13 Serial Ports Connectors

The PX30 Processor supports up to six UART Interfaces. Four of them are used on SBC-D23 board.

**RS-232 Port #A Connector – CN42**

<table>
<thead>
<tr>
<th>Pin</th>
<th>Signal</th>
<th>Pin</th>
<th>Signal</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>RS232_A_CTS</td>
<td>5</td>
<td>RS232_A_TXD</td>
</tr>
<tr>
<td>2</td>
<td>RS232_A_RTS</td>
<td>6</td>
<td>RS232_A_RXD</td>
</tr>
<tr>
<td>3</td>
<td>Vcc</td>
<td>7</td>
<td>GND</td>
</tr>
<tr>
<td>4</td>
<td>+5V_STBY</td>
<td>8</td>
<td>GND</td>
</tr>
</tbody>
</table>

UART Port #0 is made available, through a dedicated RS-232 transceiver on a dedicated Micro-fit 2x4 connector type Molex 43045-0812 or equivalent, with the pinout shown in the table on the left.

Mating connector: MOLEX 43025-0800 or equivalent with 43030 female crimp terminal.

RS232_A_TX: COM Port #0 RS-232 Mode Transmit data
RS232_A_RX: COM Port #0 RS-232 Mode Receive data
RS232_A_CTS: COM Port #0 RS-232 Mode Request to Send handshaking signal.

**RS-232 / UART Port #B Connector – CN43**

<table>
<thead>
<tr>
<th>Pin</th>
<th>Signal</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>RS232_B_TX</td>
</tr>
<tr>
<td>2</td>
<td>RS232_B_RX</td>
</tr>
<tr>
<td>3</td>
<td>RS232_B_RTS</td>
</tr>
<tr>
<td>4</td>
<td>RS232_B_CTS</td>
</tr>
<tr>
<td>5</td>
<td>GND</td>
</tr>
</tbody>
</table>

On Connector CN43, instead, it is available the UART Port #4, which can be available with RS-232 or TTL interface (factory options).

For this purpose, a dedicated 5-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.

UART Port #4 is managed as a factory alternative to microSD Slot, i.e. boards having this port available (either in RS-232 or in UART TTL mode) will not have the microSD slot mounted.

RS232_B_TX: COM Port #4 RS-232 Mode Transmit data
RS232_B_RX: COM Port #RS-232 Mode Receive data
RS232_B_CTS: COM Port #4 RS-232 Mode Request to Send handshaking signal.
RS232_B_RTS: COM Port #4 RS-232 Mode Request to Send handshaking signal.

**Debug UART Connector – CN27**

<table>
<thead>
<tr>
<th>Pin</th>
<th>Signal</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>+3P3V_SW</td>
</tr>
<tr>
<td>2</td>
<td>DUART_RX</td>
</tr>
<tr>
<td>3</td>
<td>DUART_TX</td>
</tr>
<tr>
<td>4</td>
<td>GND</td>
</tr>
</tbody>
</table>

The connector CN27, instead carries out signals related to UART #2 interface from PX30 processor. This interface can be used for the debugging of the processor.

The connector is type MOLEX p/n 53398-0471 or equivalent. Mating connector: MOLEX 51021-0400 receptacle with MOLEX 50079-8000 female crimp terminals.

DUART_TX: UART port #2 Transmit signal, +3P3V_SW electrical level
DUART_RX: UART port #2 Receive signal, +3P3V_SW electrical level
### 3.3.14 CAN Connectors

**CAN Bus Connectors – CN29, CN30**

<table>
<thead>
<tr>
<th>Pin</th>
<th>Signal</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>GND</td>
</tr>
<tr>
<td>2</td>
<td>CAN_H</td>
</tr>
<tr>
<td>3</td>
<td>CAN_L</td>
</tr>
<tr>
<td>4</td>
<td>+5V_SW</td>
</tr>
</tbody>
</table>

SBC-D23 board can offer a single CAN Bus duplicated on two connectors, in order to connect directly to two devices simultaneously using the same Bus.

The CAN Bus controller is programmed inside the on-board microcontroller, while the physical interface comes through a High-Speed CAN transceiver, type NXP TJ A1051, which offers also improved EMC and ESD performances.

The two CAN Bus Connectors are 4-pin Micro-fit 2x2 connector type Molex 43045-0424 or equivalent, as shown in the figure.

Mating connector: MOLEX 43025-0400 or equivalent with 43030 female crimp terminal

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

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

**Signals Description:**

- **CAN_H**: High-Level CAN bus line
- **CAN_L**: Low-Level CAN bus line
3.3.15 RS-485 Connector

SBC-D23 board offers also dedicated RS-485 interface, which is programmed inside the on-board microcontroller, while the physical interface comes through a ±15kV ESD protected RS-485 transceiver, type Analog Devices ADM3485E.

<table>
<thead>
<tr>
<th>Pin</th>
<th>Signal</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>RS485_D+</td>
</tr>
<tr>
<td>2</td>
<td>GND</td>
</tr>
<tr>
<td>3</td>
<td>RS485_D-</td>
</tr>
</tbody>
</table>

Always available, there is also a dedicated 3-pin connector, type 53398-0371, for the connection of external speakers (earphones).

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

Signals Description:
RS485_D+/ RS485_D-: microcontroller’s UART_3, RS-485 Mode, Differential Pair

A 120Ω termination resistor can be placed between RS485_D+ and RS485_D- signals. It can be connected or disconnected from the line by using J P3 jumper (Jumper inserted = termination connected).

When this port is available (Factory option), then USART Port #3 will not be available on connector J 2. Please check also par. 3.3.16
3.3.16  Microcontroller’s programmable connectors

The SD23 board is completed by a series of connectors with various interfaces managed by the microcontroller STM32F302VCT6. All signals available on these connectors can be used as generic I/Os, but upon specific FW programming, they can be easily adapted to implement other interfaces, all of them described in the following tables.

All signals, unless differently specified, are at 3P3V_RUN Voltage.

### Dual 2-Wire UART connector – CN32

<table>
<thead>
<tr>
<th>Pin</th>
<th>Signal</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>+3P3V_OUT_EC</td>
</tr>
<tr>
<td>2</td>
<td>EC_UART1_TX</td>
</tr>
<tr>
<td>3</td>
<td>EC_UART1_RX</td>
</tr>
<tr>
<td>4</td>
<td>GND</td>
</tr>
<tr>
<td>5</td>
<td>+3P3V_OUT_EC</td>
</tr>
<tr>
<td>6</td>
<td>EC_UART5_TX</td>
</tr>
<tr>
<td>7</td>
<td>EC_UART5_RX</td>
</tr>
<tr>
<td>8</td>
<td>GND</td>
</tr>
</tbody>
</table>

It is possible to have two 2-Wire UARTs on an 8-pin 1.25mm pitch connector type Molex p/n 53398-0871 or equivalent.

Mating connector: MOLEX 51021-0800 receptacle with MOLEX 50079-8000 female crimp terminals.

**EC_UART1_TX**: microcontroller UART port #1, Transmit signal. Connected to microcontroller’s port C, pin #4.

**EC_UART1_RX**: microcontroller UART port #1, Receive signal. Connected to microcontroller’s port C, pin #5.

**EC_UART5_TX**: microcontroller UART port #6, Transmit signal. Connected to microcontroller’s port C, pin #12.

**EC_UART5_RX**: microcontroller UART port #5, Receive signal. Connected to microcontroller’s port D, pin #3.

### Dual 4-Wire USART connector – J2

<table>
<thead>
<tr>
<th>Pin</th>
<th>Signal</th>
<th>Pin</th>
<th>Signal</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>+3P3V_OUT_EC</td>
<td>2</td>
<td>+3P3V_OUT_EC</td>
</tr>
<tr>
<td>3</td>
<td>EC_UART2_TX</td>
<td>4</td>
<td>EC_UART3_TX</td>
</tr>
<tr>
<td>5</td>
<td>EC_UART2_RX</td>
<td>6</td>
<td>EC_UART3_RX</td>
</tr>
<tr>
<td>7</td>
<td>EC_UART2_RTS/DE</td>
<td>8</td>
<td>EC_UART3_RTS/DE</td>
</tr>
<tr>
<td>9</td>
<td>EC_UART2_CTS</td>
<td>10</td>
<td>EC_UART3_CTS</td>
</tr>
<tr>
<td>11</td>
<td>EC_UART2_CLK</td>
<td>12</td>
<td>EC_UART3_CLK</td>
</tr>
<tr>
<td>13</td>
<td>GND</td>
<td>14</td>
<td>GND</td>
</tr>
</tbody>
</table>

Two others Synchronous UARTs can be made available on dedicated connector J2, which is an internal 14-pin dual row p.2.54 mm header (type MOLEX p/n 70246-1404 or equivalent).

Mating connector: MOLEX 22552141 Crimp Housing with MOLEX 70058 female crimp terminals series

**EC_UART2_TX**: microcontroller USART port #2, Transmit signal. Connected to microcontroller’s port D, pin #5.

**EC_UART2_RX**: microcontroller USART port #2, Receive signal. Connected to microcontroller’s port D, pin #6.

**EC_UART2_RTS/DE**: microcontroller USART port #2, Request To Send / Data Enable signal. Connected to microcontroller’s port D, pin #4.

**EC_UART2_CTS**: microcontroller USART port #2, Clear To Send signal. Connected to microcontroller’s port D, pin #3.

**EC_UART2_CLK**: microcontroller USART port #2, Clock signal. Connected to microcontroller’s port D, pin #7.
**EC_UART3_TX**: microcontroller UART port #3, Transmit signal. Connected to microcontroller’s port C, pin #10.

**EC_UART3_RX**: microcontroller UART port #3, Receive signal. Connected to microcontroller’s port C, pin #11.

**EC_UART3_RTS/DE**: microcontroller UART port #3, Request To Send / Data Enable signal. Connected to microcontroller’s port D, pin #12.

**EC_UART3_CTS**: microcontroller UART port #3, Clear To Send signal. Connected to microcontroller’s port D, pin #11.

**EC_UART3_CLK**: microcontroller UART port #3, Clock signal. Connected to microcontroller’s port D, pin #10.

Please be aware that UART port #3 on this connector is factory alternative to the RS-485 port available on connector CN48, i.e. board’s equipped with RS-485 will not have the signals EC_UART3_TX, EC_UART3_RX and EC_UART_RTS/DE connected to J2.

**Dual I2C connector – CN33**

<table>
<thead>
<tr>
<th>Pin</th>
<th>Signal</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>+3P3V_OUT_EC</td>
</tr>
<tr>
<td>2</td>
<td>I2C_OUT2_SDA</td>
</tr>
<tr>
<td>3</td>
<td>I2C_OUT2_SCL</td>
</tr>
<tr>
<td>4</td>
<td>GND</td>
</tr>
<tr>
<td>5</td>
<td>+3P3V_OUT_EC</td>
</tr>
<tr>
<td>6</td>
<td>I2C_OUT1_SDA</td>
</tr>
<tr>
<td>7</td>
<td>I2C_OUT1_SCL</td>
</tr>
<tr>
<td>8</td>
<td>GND</td>
</tr>
</tbody>
</table>

It is possible to have two dedicated I2C interfaces on an 8-pin 1.25mm pitch connector type Molex p/n 53398-0871 or equivalent.

Mating connector: MOLEX 51021-0800 receptacle with MOLEX 50079-8000 female crimp terminals.

**I2C_OUT1_SDA**: microcontroller I2C port #1 Data Signal. Connected to microcontroller’s port B, pin #7.

**I2C_OUT1_SCL**: microcontroller I2C port #1 Clock Signal. Connected to microcontroller’s port B, pin #6.

**I2C_OUT2_SDA**: microcontroller I2C port #2 Data Signal. Connected to microcontroller’s port A, pin #10.

**I2C_OUT2_SCL**: microcontroller I2C port #2 Clock Signal. Connected to microcontroller’s port A, pin #9.

These two I2C ports are made available on the CN33 connector through as many Dual I2C Bidirectional I2C bus voltage level translators, NXP PCA9306GF.

**SPI connector – CN39**

<table>
<thead>
<tr>
<th>Pin</th>
<th>Signal</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>+3P3V_OUT_EC</td>
</tr>
<tr>
<td>2</td>
<td>EC_SPI2_CS#</td>
</tr>
<tr>
<td>3</td>
<td>EC_SPI2_CLK</td>
</tr>
<tr>
<td>4</td>
<td>EC_SPI2_MISO</td>
</tr>
<tr>
<td>5</td>
<td>EC_SPI2_MOSI</td>
</tr>
<tr>
<td>6</td>
<td>GND</td>
</tr>
</tbody>
</table>

Another possible programmable interface is SPI, available on a 6-pin 1.25mm pitch connector type Molex p/n 53398-0671 or equivalent.

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

**EC_SPI2_CS#**: microcontroller SPI port #2, Chip Select Signal. Connected to microcontroller’s port B, pin #12.

**EC_SPI2_CLK**: microcontroller SPI port #2 Clock Signal. Connected to microcontroller’s port B, pin #13.

**EC_SPI2_MISO**: microcontroller SPI port #2 Master In Slave Out Signal. Connected to microcontroller’s port B, pin #14.

**EC_SPI2_MOSI**: microcontroller SPI port #2 Master Out Slave In Signal. Connected to microcontroller’s port B, pin #15.
It is also possible to implement many dedicated Timers on the microcontroller, which will then available on dedicated connector CN34, which is 12-pin 1.25mm pitch connector type Molex p/n 53398-1271 or equivalent.

Mating connector: MOLEX 51021-1200 receptacle with MOLEX 50079-8000 female crimp terminals.

EC_TIM1_CH1: microcontroller Advanced Timer #1, First Channel Output. Connected to microcontroller’s port E, pin #9.

EC_TIM1_CH1#: microcontroller Advanced Timer #1, First Channel Complementary Output. Connected to microcontroller’s port E, pin #10.

EC_TIM1_CH2: microcontroller Advanced Timer #2, Second Channel Output. Connected to microcontroller’s port E, pin #11.

EC_TIM1_CH2#: microcontroller Advanced Timer #2, Second Channel Complementary Output. Connected to microcontroller’s port E, pin #12.

EC_TIM1_CH3: microcontroller Advanced Timer #1, Third Channel Output. Connected to microcontroller’s port E, pin #13.

EC_TIM1_CH4: microcontroller Advanced Timer #1, Fourth Channel Output. Connected to microcontroller’s port 14, pin #14.

EC_TIM4_CH2: microcontroller Advanced Timer #4, Second Channel Output. Connected to microcontroller’s port D, pin #13.

EC_TIM4_CH3: microcontroller Advanced Timer #4, Third Channel Output. Connected to microcontroller’s port D, pin #14.

EC_TIM4_CH4: microcontroller Advanced Timer #4, Fourth Channel Output. Connected to microcontroller’s port D, pin #15.

EC_MC_OUT: microcontroller Main Clock Output. Connected to microcontroller’s port A, pin #8.

<table>
<thead>
<tr>
<th>Pin</th>
<th>Signal</th>
<th>Pin</th>
<th>Signal</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>+3P3V_OUT_EC</td>
<td>7</td>
<td>EC_TIM1_CH4</td>
</tr>
<tr>
<td>2</td>
<td>EC_TIM1_CH1</td>
<td>8</td>
<td>EC_TIM4_CH2</td>
</tr>
<tr>
<td>3</td>
<td>EC_TIM1_CH1#</td>
<td>9</td>
<td>EC_TIM4_CH3</td>
</tr>
<tr>
<td>4</td>
<td>EC_TIM1_CH2</td>
<td>10</td>
<td>EC_TIM4_CH4</td>
</tr>
<tr>
<td>5</td>
<td>EC_TIM1_CH2#</td>
<td>11</td>
<td>EC_MC_OUT</td>
</tr>
<tr>
<td>6</td>
<td>EC_TIM1_CH3</td>
<td>12</td>
<td>GND</td>
</tr>
</tbody>
</table>

**8-Channel Timer connector – CN34**
### 3.3.17 GPI and GPO Specific Connectors

The SD23 board is completed by two specific connectors for General Purpose Inputs and General Purpose Outputs, managed through dedicated octal bus buffers (SN74LVC44A), which make the GPls 5V tolerant and the GPOs able to drive outputs with up to 24mA.

These specific connectors are both type HR A1014WVA-S-2x10P or equivalent (2 x 10p, male, straight, P1, low profile, polarised) is provided, with the pin-out indicated in the following tables (different configurations are shown).

Mating connector: HR A1014H-2X10P with HR A1014-T female crimp terminals.

Alternative mating connector, MOLEX 501189-2010 with crimp terminals series 501334.

#### 16x GPO connector - CN49

<table>
<thead>
<tr>
<th>Pin</th>
<th>Signal</th>
<th>Pin</th>
<th>Signal</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>+3P3V_OUT_EC</td>
<td>2</td>
<td>+3P3V_OUT_EC</td>
</tr>
<tr>
<td>3</td>
<td>GPIO_OUTA_1</td>
<td>4</td>
<td>GPIO_OUTB_1</td>
</tr>
<tr>
<td>5</td>
<td>GPIO_OUTA_2</td>
<td>6</td>
<td>GPIO_OUTB_2</td>
</tr>
<tr>
<td>7</td>
<td>GPIO_OUTA_3</td>
<td>8</td>
<td>GPIO_OUTB_3</td>
</tr>
<tr>
<td>9</td>
<td>GPIO_OUTA_4</td>
<td>10</td>
<td>GPIO_OUTB_4</td>
</tr>
<tr>
<td>11</td>
<td>GPIO_OUTA_5</td>
<td>12</td>
<td>GPIO_OUTB_5</td>
</tr>
<tr>
<td>13</td>
<td>GPIO_OUTA_6</td>
<td>14</td>
<td>GPIO_OUTB_6</td>
</tr>
<tr>
<td>15</td>
<td>GPIO_OUTA_7</td>
<td>16</td>
<td>GPIO_OUTB_7</td>
</tr>
<tr>
<td>17</td>
<td>GPIO_OUTA_8</td>
<td>18</td>
<td>GPIO_OUTB_8</td>
</tr>
<tr>
<td>19</td>
<td>GND</td>
<td>20</td>
<td>GND</td>
</tr>
</tbody>
</table>

**GPIO_OUTA_1**: GP Output Port #A Out 1. Managed by microcontroller’s port A, pin #0.
**GPIO_OUTA_2**: GP Output Port #A Out 2. Managed by microcontroller’s port A, pin #1.
**GPIO_OUTA_3**: GP Output Port #A Out 3. Managed by microcontroller’s port A, pin #2.
**GPIO_OUTA_4**: GP Output Port #A Out 4. Managed by microcontroller’s port A, pin #3.
**GPIO_OUTA_5**: GP Output Port #A Out 5. Managed by microcontroller’s port B, pin #0.
**GPIO_OUTA_6**: GP Output Port #A Out 6. Managed by microcontroller’s port B, pin #1.
**GPIO_OUTA_7**: GP Output Port #A Out 7. Managed by microcontroller’s port B, pin #2.
**GPIO_OUTA_8**: GP Output Port #A Out 8. Managed by microcontroller’s port B, pin #10.
**GPIO_OUTB_1**: GP Output Port #B Out 1. Managed by microcontroller’s port B, pin #11.
**GPIO_OUTB_2**: GP Output Port #B Out 2. Managed by microcontroller’s port C, pin #0.
**GPIO_OUTB_3**: GP Output Port #B Out 3. Managed by microcontroller’s port C, pin #1.
**GPIO_OUTB_4**: GP Output Port #B Out 4. Managed by microcontroller’s port C, pin #2.
**GPIO_OUTB_5**: GP Output Port #B Out 5. Managed by microcontroller’s port C, pin #3.
**GPIO_OUTB_6**: GP Output Port #B Out 6. Managed by microcontroller’s port C, pin #6.
**GPIO_OUTB_7**: GP Output Port #B Out 7. Managed by microcontroller’s port A, pin #5.
**GPIO_OUTB_8**: GP Output Port #B Out 8. Managed by microcontroller’s port A, pin #6.
16x GPIO connector – CN50

<table>
<thead>
<tr>
<th>Pin</th>
<th>Signal</th>
<th>Pin</th>
<th>Signal</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>+3.3V_OUT_EC</td>
<td>2</td>
<td>+3.3V_OUT_EC</td>
</tr>
<tr>
<td>3</td>
<td>GPIO_INPUTA_1</td>
<td>4</td>
<td>GPIO_INPUTB_1</td>
</tr>
<tr>
<td>5</td>
<td>GPIO_INPUTA_2</td>
<td>6</td>
<td>GPIO_INPUTB_2</td>
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<tr>
<td>7</td>
<td>GPIO_INPUTA_3</td>
<td>8</td>
<td>GPIO_INPUTB_3</td>
</tr>
<tr>
<td>9</td>
<td>GPIO_INPUTA_4</td>
<td>10</td>
<td>GPIO_INPUTB_4</td>
</tr>
<tr>
<td>11</td>
<td>GPIO_INPUTA_5</td>
<td>12</td>
<td>GPIO_INPUTB_5</td>
</tr>
<tr>
<td>13</td>
<td>GPIO_INPUTA_6</td>
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<tr>
<td>15</td>
<td>GPIO_INPUTA_7</td>
<td>16</td>
<td>GPIO_INPUTB_7</td>
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<tr>
<td>17</td>
<td>GPIO_INPUTA_8</td>
<td>18</td>
<td>GPIO_INPUTB_8</td>
</tr>
<tr>
<td>19</td>
<td>GND</td>
<td>20</td>
<td>GND</td>
</tr>
</tbody>
</table>

GPIO_INPUTA_1: GP Input Port #A Out 1. Managed by microcontroller’s port C, pin #7.
GPIO_INPUTA_2: GP Input Port #A Out 2. Managed by microcontroller’s port C, pin #8.
GPIO_INPUTA_5: GP Input Port #A Out 5. Managed by microcontroller’s port D, pin #1.
GPIO_INPUTA_6: GP Input Port #A Out 6. Managed by microcontroller’s port E, pin #0.
GPIO_INPUTA_7: GP Input Port #A Out 7. Managed by microcontroller’s port E, pin #1.
GPIO_INPUTA_8: GP Input Port #A Out 8. Managed by microcontroller’s port E, pin #2.
GPIO_INPUTB_1: GP Input Port #B Out 1. Managed by microcontroller’s port E, pin #3.
GPIO_INPUTB_2: GP Input Port #B Out 2. Managed by microcontroller’s port E, pin #4.
GPIO_INPUTB_3: GP Input Port #B Out 3. Managed by microcontroller’s port E, pin #5.
GPIO_INPUTB_5: GP Input Port #B Out 5. Managed by microcontroller’s port F, pin #9.
GPIO_INPUTB_7: GP Input Port #B Out 7. Managed by microcontroller’s port E, pin #8.
GPIO_INPUTB_8: GP Input Port #B Out 8. Managed by microcontroller’s port A, pin #7.
3.3.18  STM32 Programming Connector

Since many features of the board depend on its FW programming, it is given the possibility to the user to program it by themselves using connector CN56, which is an 8-pin 1.25mm pitch connector type Molex p/n 53398-0871 or equivalent.

Mating connector: MOLEX 51021-0800 receptacle with MOLEX 50079-8000 female crimp terminals.

Pin  Signal
1   +3P3V_RUN
2   DBG_TXD
3   DBG_RXD
4   BOOT0
5   SWDIO/J TMS
6   SWCLK/J TCK
7   EC_RST#
8   GND

- SWDIO/J TMS: Serial Wire Debug/JTAG TMS input
- SWDIO/J TCLK: Serial Wire Debug/JTAG TCK input
- BOOT_0: Boot selection pin. Electrical Level +3P0V_VDD_PMU with 10K pull-down resistor, directly connected to microcontroller’s pin BOOT0
- EC_RST#: microcontroller’s reset input, also driven by the PX30 processor. Electrical Level +3P0V_VDD_PMU with 10K pull-up resistor
- DBG_TXD: microcontroller’s Debug UART transmit signal (only in case that corresponding STM32 signal is not used as I2C_OUT2_SCL signal on CN33 connector).

DBG_RXD: microcontroller’s Debug UART receive signal (only in case that corresponding STM32 signal is not used as I2C_OUT2_SDA signal on CN33 connector).

Please be aware that using some programmers it could arise electrical incompatibilities on EC_RST# signal. In these cases, please set “Software Reset” in the programming tool.

3.3.19  ON/OFF and Reset Connector

SD23 board can offer a dual push-button switch (P/N HY-1102HLT-A95B50) 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.
3.3.20 UPS By-pass connector

The SBC-D23 board allow the possibility of connecting external UPS modules able to supply a 12V Backup, to be used in case that the main power supply is not available.

For this kind of connection, it is provided a standard Micro-fit 2x7 connector type Molex 43045-1412 or equivalent, with the pinout shown in the table on the left.

Mating connector: MOLEX 43025-1400 or equivalent with 43030 female crimp terminal.

UPS_BYPASS: UPS power rail enable signal. Used to switch between the power rail coming from the external UPS Module and the standard V_IN Power Supply. Electrical level +12V_ALW with 100Ω pull-up resistor.

UPS_PFO#: Generic Input. It is managed on the SBC-D23 board by I/O Expander B, Port #0 Pin #0. Electrical level +3.3V_RUN.

UPS_INT#: This signal can be used to serve the interrupt request of the UPS device. It is managed on the SBC-D23 board by I/O Expander B, Port #0 Pin #1. Electrical level +3.3V_RUN.

UPS_EN: IO: Generic UPS Enable signal. It is managed on the SBC-D23 board by I/O Expander A, Port #0 Pin #1. Electrical level +3.3V_RUN.

UPS_BOOST_EN: Generic UPS Enable signal. It is managed on the SBC-D23 board by I/O Expander A, Port #0 Pin #0. Electrical level +3.3V_RUN.

<table>
<thead>
<tr>
<th>Pin</th>
<th>Signal</th>
<th>Pin</th>
<th>Signal</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>---</td>
<td>8</td>
<td>+12V_BACKUP</td>
</tr>
<tr>
<td>2</td>
<td>VDD_SYS</td>
<td>9</td>
<td>---</td>
</tr>
<tr>
<td>3</td>
<td>---</td>
<td>10</td>
<td>+12V_BACKUP</td>
</tr>
<tr>
<td>4</td>
<td>VDD_SYS</td>
<td>11</td>
<td>UPS_BOOST_EN</td>
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<tr>
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<td>UPS_PFO#</td>
<td>12</td>
<td>GND</td>
</tr>
<tr>
<td>6</td>
<td>UPS_BYPASS</td>
<td>13</td>
<td>UPS_EN</td>
</tr>
<tr>
<td>7</td>
<td>UPS_INT#</td>
<td>14</td>
<td>GND</td>
</tr>
</tbody>
</table>

Pin #1. Electrical level +3.3V_RUN

UPS_BOOST_EN: Generic UPS Enable signal.
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-D23 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-D23 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-D23 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.

<table>
<thead>
<tr>
<th>Ordering Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASK-948</td>
<td>Heatsink unit for SD23 board</td>
</tr>
</tbody>
</table>

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.