

# SMARC-fA3399

Doc. Rev. 1.0

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 SMARC-FA3399 – USER GUIDE

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## Revision History

Revision	Brief Description of Changes	Date of Issue	Author
0.1	Initial Issue	2021-February-17	uma
0.2	Corrected some errors and temperature specification	2021-May-28	uma
0.3	Added Software Update description	2021-June-18	uma
1.0	Final version	2021-July-02	uma

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THIS DEVICE AND ASSOCIATED SOFTWARE ARE NOT DESIGNED, MANUFACTURED OR INTENDED FOR USE OR RESALE FOR THE OPERATION OF NUCLEAR FACILITIES, THE NAVIGATION, CONTROL OR COMMUNICATION SYSTEMS FOR AIRCRAFT OR OTHER TRANSPORTATION, AIR TRAFFIC CONTROL, LIFE SUPPORT OR LIFE SUSTAINING APPLICATIONS, WEAPONS SYSTEMS, OR ANY OTHER APPLICATION IN A HAZARDOUS ENVIRONMENT, OR REQUIRING FAIL-SAFE PERFORMANCE, OR IN WHICH THE FAILURE OF PRODUCTS COULD LEAD DIRECTLY TO DEATH, PERSONAL INJURY, OR SEVERE PHYSICAL OR ENVIRONMENTAL DAMAGE (COLLECTIVELY, "HIGH RISK APPLICATIONS").

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### **▲ CAUTION**

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Handling and operation of the product is permitted only for trained personnel within a work place that is access controlled. Please follow the "General Safety Instructions for IT Equipment" supplied with the system.

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## Symbols

The following symbols may be used in this manual

### **⚠ DANGER**

DANGER indicates a hazardous situation which, if not avoided, will result in death or serious injury.

### **⚠ WARNING**

WARNING indicates a hazardous situation which, if not avoided, could result in death or serious injury.

### **⚠ CAUTION**

CAUTION indicates a hazardous situation which, if not avoided, may result in minor or moderate injury.

### **NOTICE**

NOTICE indicates a property damage message.



#### **Electric Shock!**

This symbol and title warn of hazards due to electrical shocks (> 60 V) when touching products or parts of them. Failure to observe the precautions indicated and/or prescribed by the law may endanger your life/health and/or result in damage to your material.

Please refer also to the "High-Voltage Safety Instructions" portion below in this section.



#### **ESD Sensitive Device!**

This symbol and title inform that the electronic boards and their components are sensitive to static electricity. Care must therefore be taken during all handling operations and inspections of this product in order to ensure product integrity at all times.



#### **HOT Surface!**

Do NOT touch! Allow to cool before servicing.



This symbol indicates general information about the product and the user manual.

This symbol also indicates detail information about the specific product configuration.



This symbol precedes helpful hints and tips for daily use.

## For Your Safety

Your new Kontron product was developed and tested carefully to provide all features necessary to ensure its compliance with electrical safety requirements. It was also designed for a long fault-free life. However, the life expectancy of your product can be drastically reduced by improper treatment during unpacking and installation. Therefore, in the interest of your own safety and of the correct operation of your new Kontron product, you are requested to conform with the following guidelines.

### High Voltage Safety Instructions

As a precaution and in case of danger, the power connector must be easily accessible. The power connector is the product's main disconnect device.

#### ⚠ CAUTION

##### Warning

All operations on this product must be carried out by sufficiently skilled personnel only.

#### ⚠ CAUTION



##### Electric Shock!

Before installing a non hot-swappable Kontron product into a system always ensure that your mains power is switched off. This also applies to the installation of piggybacks. Serious electrical shock hazards can exist during all installation, repair, and maintenance operations on this product. Therefore, always unplug the power cable and any other cables which provide external voltages before performing any work on this product.

Earth ground connection to vehicle's chassis or a central grounding point shall remain connected. The earth ground cable shall be the last cable to be disconnected or the first cable to be connected when performing installation or removal procedures on this product.

### Special Handling and Unpacking Instruction

#### NOTICE



##### ESD Sensitive Device!

Electronic boards and their components are sensitive to static electricity. Therefore, care must be taken during all handling operations and inspections of this product, in order to ensure product integrity at all times.

Do not handle this product out of its protective enclosure while it is not used for operational purposes unless it is otherwise protected.

Whenever possible, unpack or pack this product only at EOS/ESD safe work stations. Where a safe work station is not guaranteed, it is important for the user to be electrically discharged before touching the product with his/her hands or tools. This is most easily done by touching a metal part of your system housing.

It is particularly important to observe standard anti-static precautions when changing piggybacks, ROM devices, jumper settings etc. If the product contains batteries for RTC or memory backup, ensure that the product is not placed on conductive surfaces, including anti-static plastics or sponges. They can cause short circuits and damage the batteries or conductive circuits on the product.

## General Instructions on Usage

In order to maintain Kontron's product warranty, this product must not be altered or modified in any way. Changes or modifications to the product, that are not explicitly approved by Kontron and described in this User Guide or received from Kontron's Technical Support as a special handling instruction, will void your warranty.

This product should only be installed in or connected to systems that fulfill all necessary technical and specific environmental requirements. This also applies to the operational temperature range of the specific board version, that must not be exceeded. If batteries are present, their temperature restrictions must be taken into account.

In performing all necessary installation and application operations, only follow the instructions supplied by the present User Guide.

Keep all the original packaging material for future storage or warranty shipments. If it is necessary to store or ship the product then re-pack it in the same manner as it was delivered.

Special care is necessary when handling or unpacking the product. See Special Handling and Unpacking Instruction.

## Environmental Protection Statement

This product has been manufactured to satisfy environmental protection requirements where possible. Many of the components used (structural parts, printed circuit boards, connectors, batteries, etc.) are capable of being recycled.

Final disposition of this product after its service life must be accomplished in accordance with applicable country, state, or local laws or regulations.




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Environmental protection is a high priority with Kontron.  
Kontron follows the WEEE directive  
You are encouraged to return our products for proper disposal.

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The Waste Electrical and Electronic Equipment (WEEE) Directive aims to:

Reduce waste arising from electrical and electronic equipment (EEE)

Make producers of EEE responsible for the environmental impact of their products, especially when the product become waste

Encourage separate collection and subsequent treatment, reuse, recovery, recycling and sound environmental disposal of EEE

Improve the environmental performance of all those involved during the lifecycle of EEE



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# 1/ Introduction

This manual describes the Smart Mobility ARChitecture (SMARC) fA3399 board. The extrem powerful module with six core Rockchip RK3399K processors offers an extremely high performance output. Based on a dual Cortex-A72 and quad Cortex-A53 cores, they enable an efficient development of smart devices in an extremely compact design with high processor and graphics performance.

The use of this Users Guide implies a basic knowledge of PC hard- and software. This manual is focused on describing the special features and is not intended to be a standard PC textbook. New users are recommended to study the short installation procedure stated in the following chapter before switching on the power.

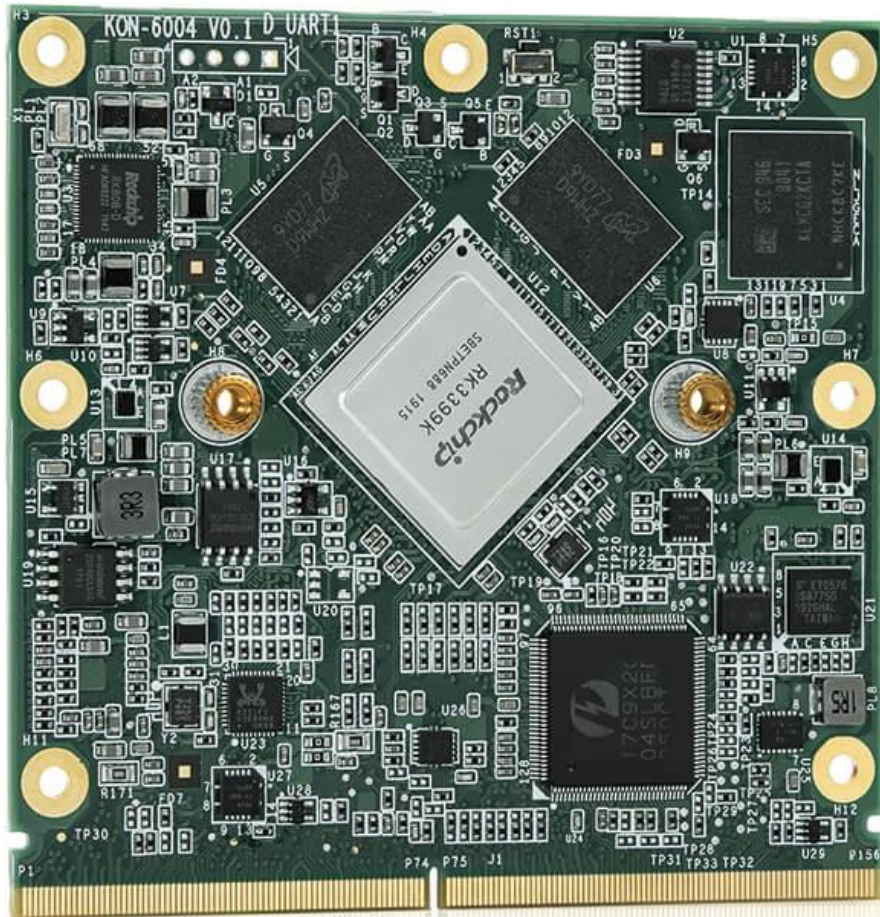
All configuration and setup of the CPU board is done either automatically or manually by the user via the BIOS setup menus.

Latest revision of this manual, datasheet, BIOS, drivers and BSP's (Board Support Packages) can be downloaded from Kontron Web Page.

## 2/ Description

The SMARC-fA3399 is a SMARC full-size module using the Rockchip RK3399K processor with dual Cortex-A72 and quad Cortex-A53 ARM cores. It is designed on the latest SMARC 2.1 specification. The SMARC-fA3399 is a highly integrated, embedded computer board with an excellent performance/price ratio.

Figure 1: Full-size Card with SMARC interface



## 2.1. SMARC™ Computer-on-Modules

The SMARC™ standard was developed especially for new modules with ARM- and SoC-processors. Boards with this interfaces are characterized by the extremely flat form factor. The SMARC or MXM 3.0 connector comes with 314 pins and a construction height of just 4.3 millimeters. The connector is also available in a shock- and vibration-resistant version for rough environmental conditions.

Furthermore, the standard integrates dedicated interfaces for the latest ARM, x86 and SoC processors like LVDS and Gigabit Ethernet. In addition, dedicated camera interfaces are being incorporated into a COM standard. OEMs profit from minimized design effort and low Bill of Material (BoM) costs. SMARC™ defines two different module sizes in order to offer a high level of flexibility regarding different mechanical requirements.

## 2.2. Main characteristics

Main characteristics of the SMARC-fA3399 are:

- ▶ SOC: RK3399K from Rockchip with dual Cortex-A72 and quad Cortex-A53 ARM cores.
- ▶ Up to 4 GB LPDDR4 memory down
- ▶ 3D Graphics Engine: ARM® Mali-T860MP4
- ▶ LVDS support (via eDP), eDP on request
- ▶ DP
- ▶ HDMI
- ▶ 1x Gigabit Ethernet with internal MAC and PHY
- ▶ 1x GB via PCIe controller
- ▶ 3x PCIe x1 lines
- ▶ Support for Audio and common features (SPI, I2C, SMB etc.)
- ▶ eMMC flash onboard
- ▶ Extended temperature range (-20°C up to +60°C) for standard SKUs, commercial version possible

## 2.3. Product Variants and Accessories

Following variants are planned:

**Table 1: Product Variants of SMARC-sfA3399**

Part No.	CPU	RAM	Flash	LAN	Display	OP. Temperature
51015-0464-18-6	RK3399K	4 GByte	64 GByte	2x 1GByte	LVDS, HDMI, DP	-25°C - 60°C

Following accessories are available:

- |                                  |                 |
|----------------------------------|-----------------|
| ▶ Heatspreader: HSP SMARC-fA3399 | 51015-0000-99-1 |
| ▶ SMARC 2.0 Evaluation Carrier:  | 51300-0000-00-0 |
| ▶ SMARC Mounting Kit:            | 51117-0000-00-0 |

## 2.4. SMARC-fA3399 Feature Set

Table 2: SMARC-fA3399 Feature Set

SMARC™ Feature specification	SMARC™ Specification Maximum Number Possible	SMARC-fA3399 Feature support	Description
LVDS Display support	1	1x	MIPI-DSI/LVDS Combo PHY – on customer request: eDP support possible
HDMI	1	1x	HDMI 1.4 and 2.0 operation
DP	1	1x	Compliant with DisplayPort Specification 1.2
CSI Camera support	2	2x	2 x MIPI CSI with 2lane and 4lane support
USB Interface	6 x USB 2.0 with 2 x USB 3.0 included	4 x USB 2.0 with 1x USB 3.0 included	USB #0 to #3 available, USB #2 with SuperSpeed support
PCIe Interface	4	3x	Possible configurations: 1: 2x PCIe (with PCIe bridge, 2 <sup>nd</sup> LAN) 2: 1x PCIe (no PCIe bridge, no 2 <sup>nd</sup> LAN) 3: 0x PCIe (no PCIe bridge, 2 <sup>nd</sup> LAN) 4: 3x PCIe (with PCIe bridge, no 2 <sup>nd</sup> LAN)
GbE Interface	2	2x GbE	GBE0: via RGMII/Realtek PHY GBE1: via Intel i210 PCIe controller
SDIO Interface	1	1x	
SPI Interface	2	2x	
I2S Interface	2	2x	
I2C Interface	5	4x	I2C_GP, I2C_PM, I2C (LVDS), I2C (HDMI)
CAN	2	0	No support on RK3399
UART	4	2x	SER0 (4wire), SER1 (2wire)
GPIOs	14	12x GPIOs	6x output, 6x input

## 3/ System Specifications

### 3.1. Component Main Data

The table below summarizes the features of the Computer-on-Module.

Table 3: Component Main Data

SMARC-fA3399	
Form factor	Full size Smart Mobility ARChitecture (SMARC) Hardware with 82 mm x 80 mm, max. thickness 6 mm
Processor	Rockchip RK3399K 21mm x 21mm FCBGA828 package with 0.35 mm ball size and 0.65mm pitch
Memory	LPDDR4 @ 1200 MHz (no ECC) Maximum 4GB
Boot Flash	128 Mbit connected to SPI
Bootloader/BIOS	U-Boot Bootloader, Flash for Bootloader connected on SPI1 of SOC
embedded Multimedia Card (eMMC)	<ul style="list-style-type: none"> <li>▶ 2 to 64 GB pseudo Single Level Cell (pSLC)</li> <li>▶ 4 to 128 GB MLC (Multi-level Cell)</li> </ul>
EEPROM	<ul style="list-style-type: none"> <li>▶ Type: 24C32, 4k x 8 (32 kbit)</li> <li>▶ Connected at I2C_GP bus at address 0x50 (7-bit)</li> </ul>
Display Interfaces	<ul style="list-style-type: none"> <li>▶ LVDS 18/24-bit LVDS RGB (True Color) from MIPI-DSI (alternatively eDP as option)</li> <li>▶ HDMI</li> <li>▶ DisplayPort</li> </ul>
Onboard Controllers	
Ethernet Controller	1x GBE PHY RTL8211FI, second ETH controller I210 optionally with PCIe switch
Watchdog Timer	CPU internal watchdog, configurable timeout counter.
PCI Switch	PCIe packet switch PI7C9X2G4045L
Display bridge	MIPI DSI to LVDS Flatlink SN65DSI84ZQER
Real Time Clock (RTC)	Included in PMIC RK808-D
System Management Controller	No dedicated System Management Controller on module System settings can be arranged in U-Boot environment variables
Storage	
Storage	2 to 128 GB eMMC 5.0 Flash (option)
H/W Status Monitor	Voltage monitoring
Power management	<ul style="list-style-type: none"> <li>▶ Rockchip PMIC RK808-D</li> </ul>
Operating System Support	Linux Yocto, other Operating Systems only on customer request
Interfaces via Smarc I/O	
I2C	External Fast I2C_GP (I2C1 on RK3399) CPU I2C_PM for Power Management (I2C4 on RK3399)
LAN, USB	1x Gb-Ethernet + 1x Gb-Ethernet optional via PCIe controller, 1x USB 3.0 on USB#2, 4x USB 2.0 xHCI



<b>PCIe</b>	<p>Konfiguration 1 (default)</p> <ul style="list-style-type: none"> <li>▶ PCIe Switch and LAN Controller</li> <li>▶ 2x PCIe at SMARC connector via PCIe SW (PCIeA + PCIeB)</li> <li>▶ 1x PCIe to LAN Controller via PCIe SW</li> <li>▶ Second Ethernet on ETH1</li> </ul> <p>Konfiguration 2 (economic)</p> <ul style="list-style-type: none"> <li>▶ Without PCIe Switch and LAN Controller</li> <li>▶ 1x PCIe A on SMARC connector directly from i.MX8 CPU</li> <li>▶ No ETH1</li> </ul> <p>Konfiguration 3 (dual LAN, no PCIe)</p> <ul style="list-style-type: none"> <li>▶ Without PCIe Switch and with LAN Controller</li> <li>▶ No PCIe at SMARC connectors</li> <li>▶ LAN Controller directly connected to PCIe from CPU</li> </ul> <p>Konfiguration 4 (PCIe, no 2nd LAN)</p> <ul style="list-style-type: none"> <li>▶ PCIe Switch and without LAN Controller</li> <li>▶ 3x PCIe at SMARC connector via PCIe SW (PCIe A, PCIeB, PCIeC)</li> <li>▶ No ETH1</li> </ul>
<b>Audio</b>	Carrier board Audio with external I2S Codec
<b>Display</b>	Dual channel LVDS 1/2x18/24bit (openLDI and VESA) up to 1920x1200 from MIPI-DSI, optional eDP, HDMI, DP
<b>Camera</b>	2x MIPI CSI camera support default: 2lane, 4lane
<b>SD-Card</b>	1x SDIO
<b>Serial Peripheral Interface (SPI)</b>	2 x SPI interface on defined pins
<b>SER</b>	2x serial ports with full function according to SMARC 2.0.
<b>GPIO</b>	12x General Purpose Inputs/Outputs (GPIO)
<b>Power</b>	
<b>Input Voltage</b>	5V +/- 5%
<b>Power Supply Limits</b>	Voltage Ripple maximum 200mV peak to peak at 0 to 20 MHz 0.1 to 20ms rise time from input voltage $\leq 10\%$ to nominal VCC inrush current peak limit. G3/S5 to S0 acc. SFX Design Guide
<b>Power Features</b>	<ul style="list-style-type: none"> <li>▶ Module shall power on automatically in single supply operation when VCC is connected</li> </ul>
<b>Security</b>	
	<ul style="list-style-type: none"> <li>▶ TrustZone®</li> <li>▶ AES256, SHA-256</li> <li>▶ 3DES, MD-5</li> <li>▶ PRNG 160-bit</li> <li>▶ TRNG 256-bit</li> </ul>

### 3.2. Environmental Conditions

Table 4: Environmental Conditions

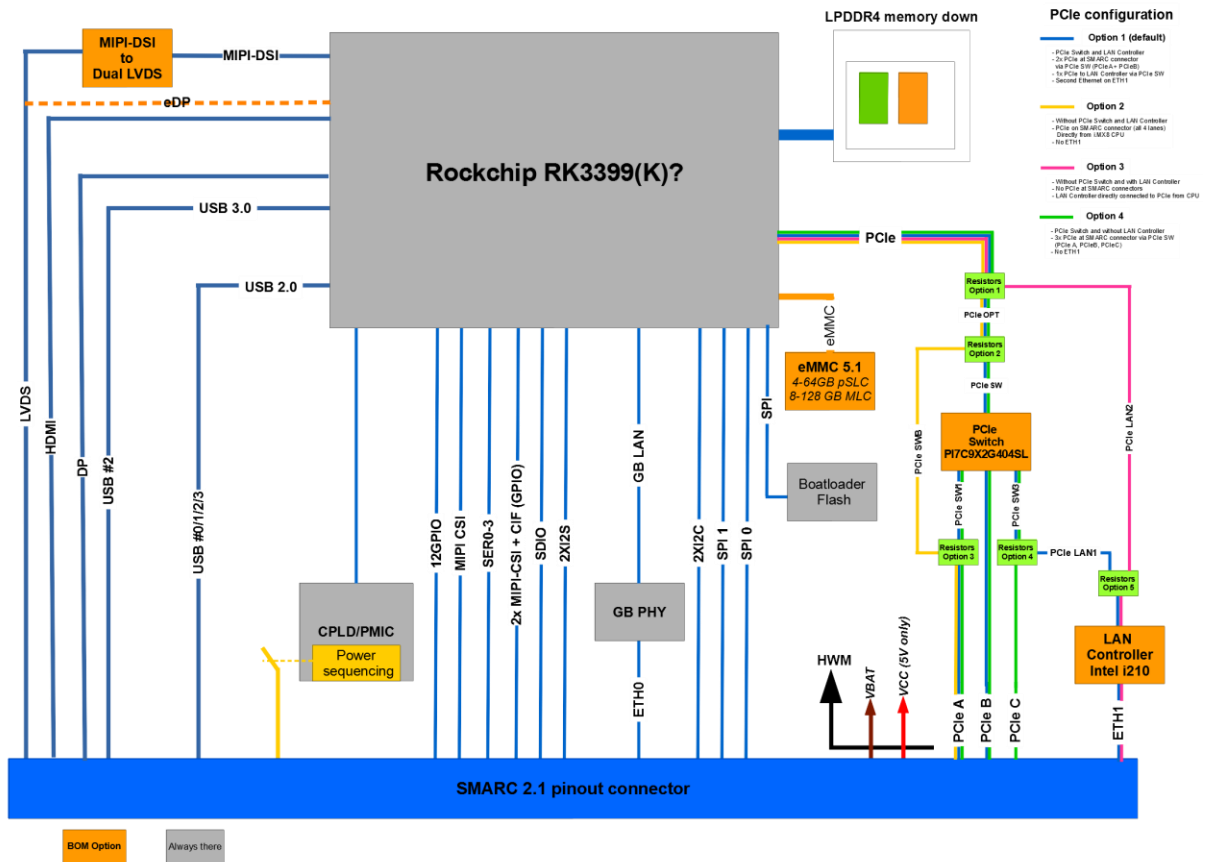
<b>Operating</b>	<ul style="list-style-type: none"> <li>▶ 0°C to 60°C (on request for cost optimization)</li> <li>▶ -20°C to 60°C (by design)</li> </ul>
<b>Storage</b>	<ul style="list-style-type: none"> <li>▶ -40°C to +85°C</li> </ul>
<b>Relative Humidity</b>	<ul style="list-style-type: none"> <li>▶ non-condensing 10 % to 93 % at 40°C acc. to IEC 60068-2-78</li> </ul>

<b>Electromagnetic Compatibility (EMC)</b>	According to EN55022 (Class B), EN61000-6-2 and EN61000-6-4
<b>CE</b>	EN 62368-1:2014 - Safety for audio/video and information technology equipment
<b>UL</b>	Component Recognition to UL60950-1 - Information Technology Equipment Including Electrical Business Equipment
<b>REACH</b>	REACH compliant (Regulation (EC) No 1907/2006)
<b>WEEE</b>	WEEE compliant (Directive 2012/19/EU)
<b>Shock and Vibration</b>	Shock & Vibration according to <ul style="list-style-type: none"> <li>▶ IEC/EN60068-2-27 (Non-operating shock test – half-sinusoidal, 11 ms, 15 g) and</li> <li>▶ IEC/EN60068-2-6 (Non-operating vibration – sinusoidal, 10 Hz – 4000 Hz, +/- 0.15 mm, 2 g)</li> </ul>
<b>Theoretical MTBF</b>	estimated <b>TBD</b> years at 40°C
<b>RoHS II Compliance</b>	The product is RoHS II compliant (Directive 2011/65/EU)

### 3.3. Functional Block Diagram

The block diagram shows all available interfaces on the fA3399 module.

Figure 2: Block Diagram



## 4/ Board and Connectors

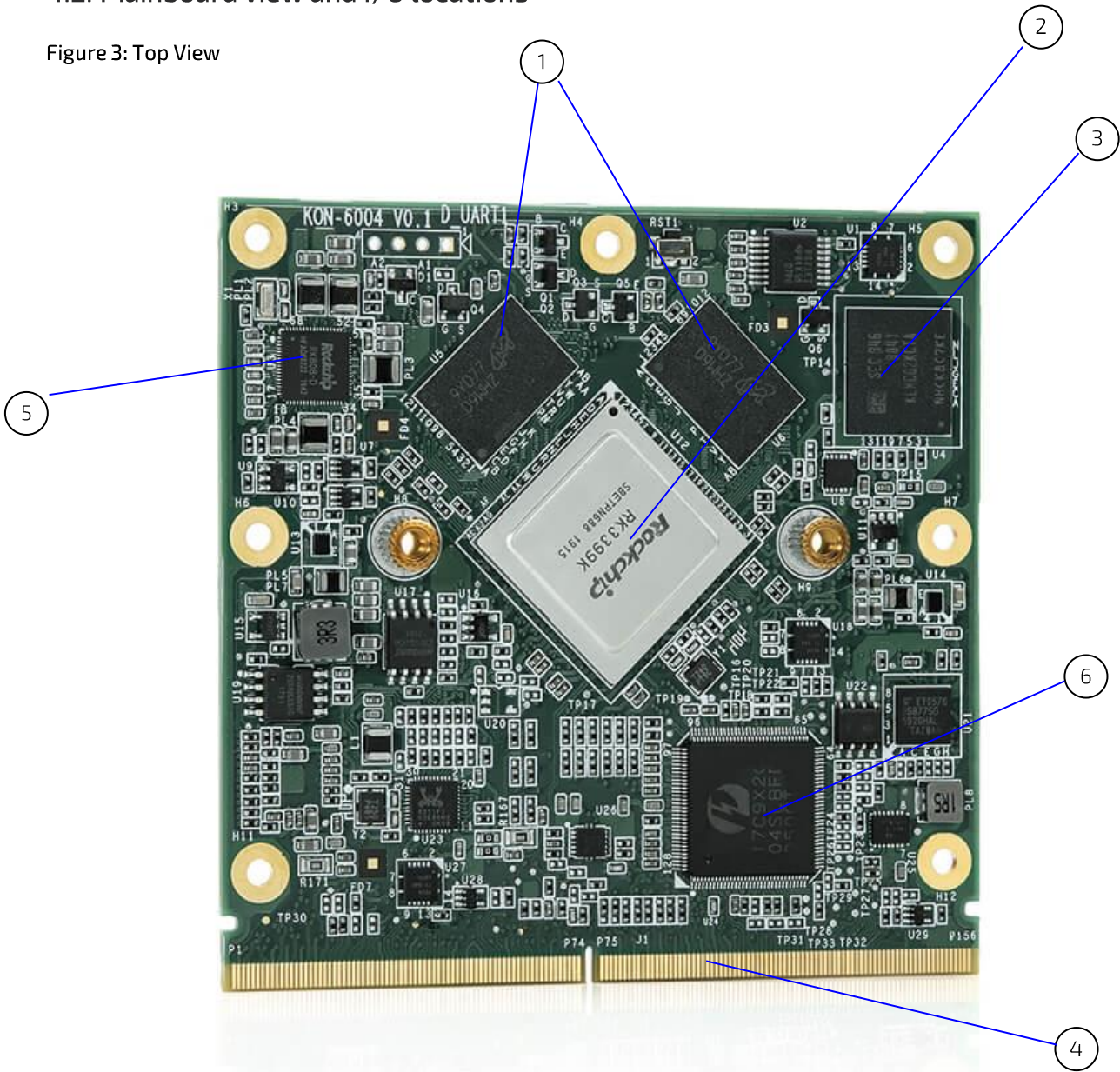
### 4.1.1. Connectors

Table 5: Connectors of SMARC-fA3399

Connector	Function	Remark
SMARC	Central Interface	Mating connector: SMARC 2.1 (MXM3)

## 4.2. Mainboard view and I/O locations

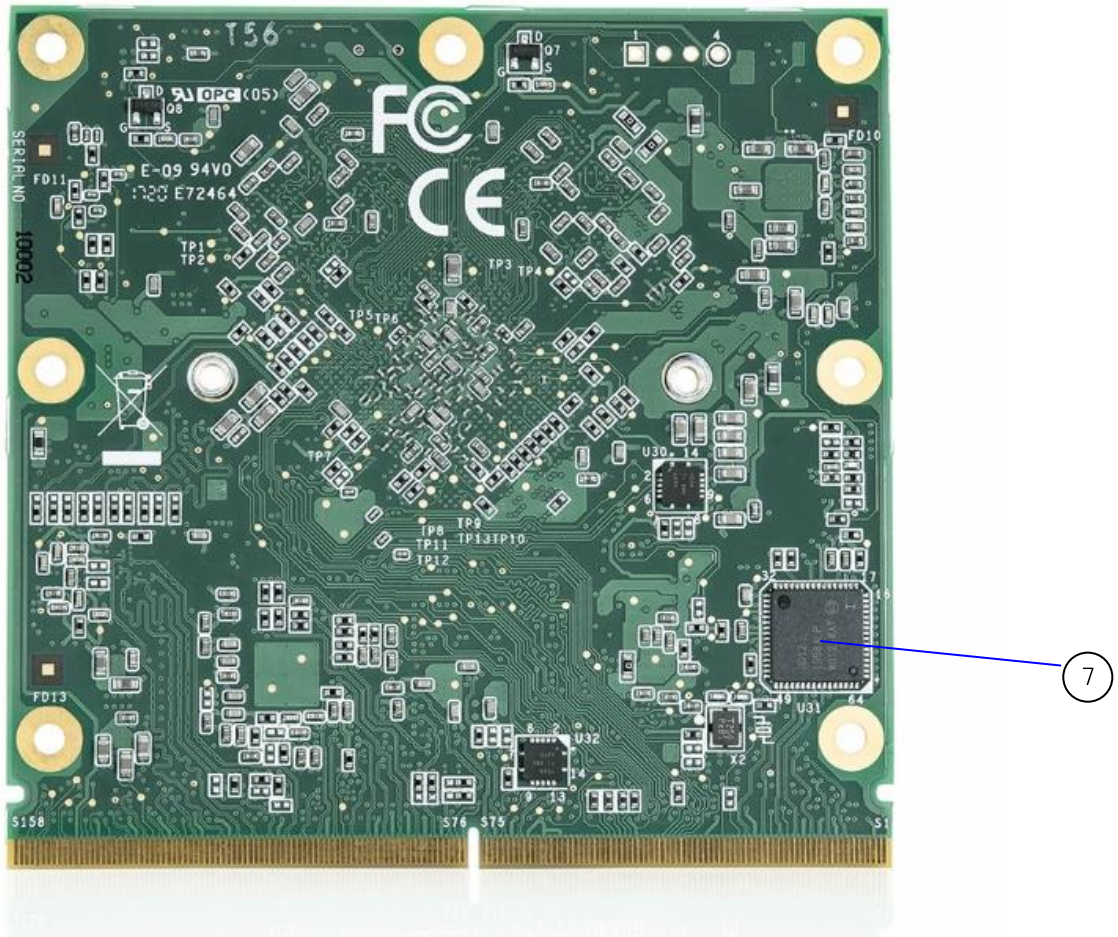
Figure 3: Top View



1. LPDDR4 memory
2. Rockchip RK3399K Processor
3. embedded MultiMedia Card (eMMC)
4. SMARC Interface
5. Power Management IC
6. PCIe switch (optional)

### 4.3. Bottom Side

Figure 4: Bottom Side from SMARC-fA3399



7. Ethernet Controller (optional)

## 4.4. Mechanical Drawings

Figure 5: Dimensions of SMARC-fA3399

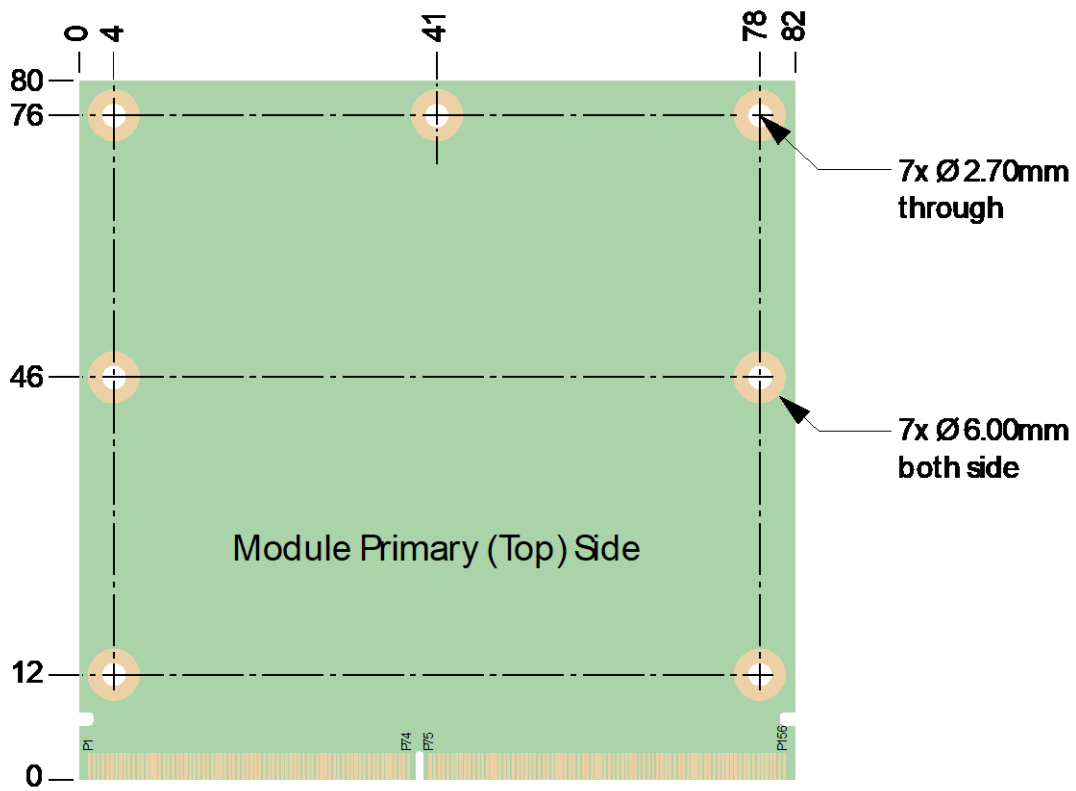


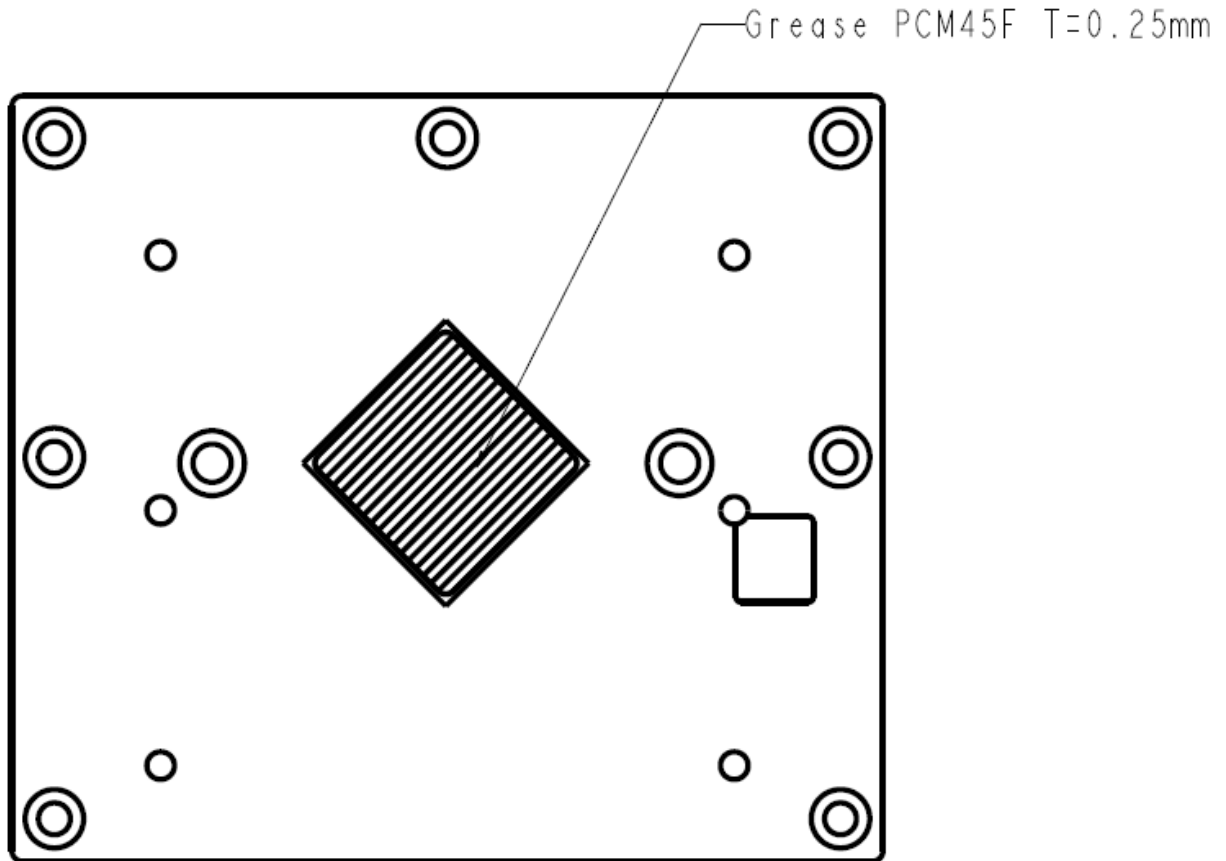
Figure 6: Thickness from side view



## 4.5. Thermal Considerations

The Cooling concept is based on a standard cooler for SMARC modules with mounting holes for SMARC-fA3399 module.

Figure 7: Heatspreader Bottom View



**NOTICE**

Heat spreader mech. data are available on customer section



## 5/ Pin Definitions

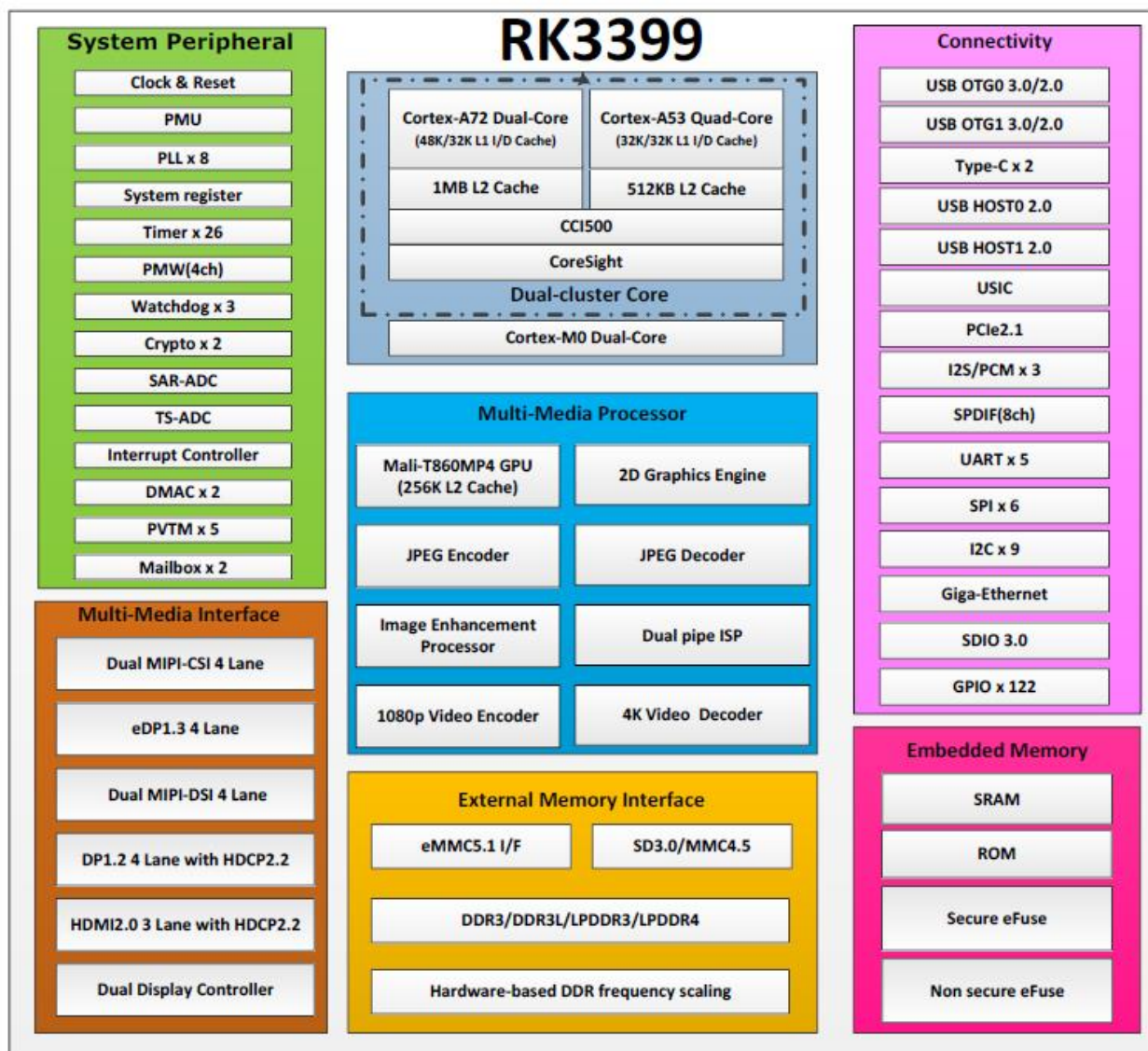
### 5.1. Processor Support

Kontron uses a Rockchip RK3399(K) chip with with 21 mm x 21 mm BGA package in 0.65 mm pitch available.

Table 6: Processor Support

Name	Speed	RAM	Cache	Tj
RK3399K	2x 1.2 GHz			-20°C to 80°C
RK3399	2x 1.2 GHz			-0°C to 80°C

Figure 8: Processor Block Diagram (Source: Rockchip)



## 5.2. System Memory Support

The system supports the following memory features:

- ▶ LPDDR4 (no ECC)
- ▶ Maximum 4GB DRAM supported

**Table 7: Memory Options**

Possible Memory Sizes
1 GB
2 GB
4 GB

### 5.3. eMMC Flash Memory

An optional embedded Multimedia Flash Card (eMMC) complying with the eMMC 5.1 specification can be permanently attached to the module, allowing for a capacity of up to 64 GByte NAND Flash. Optionally during the SMARC-fA3399's manufacturing process, Multi Level Cell (MLC) eMMC could be reconfigured to act as a pseudo Single Level Cell (pSLC) eMMC to provide improved reliability, endurance and performance.

**NOTICE**

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eMMC is default assembled 64 GB.

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Specific eMMC Flash memory features are:

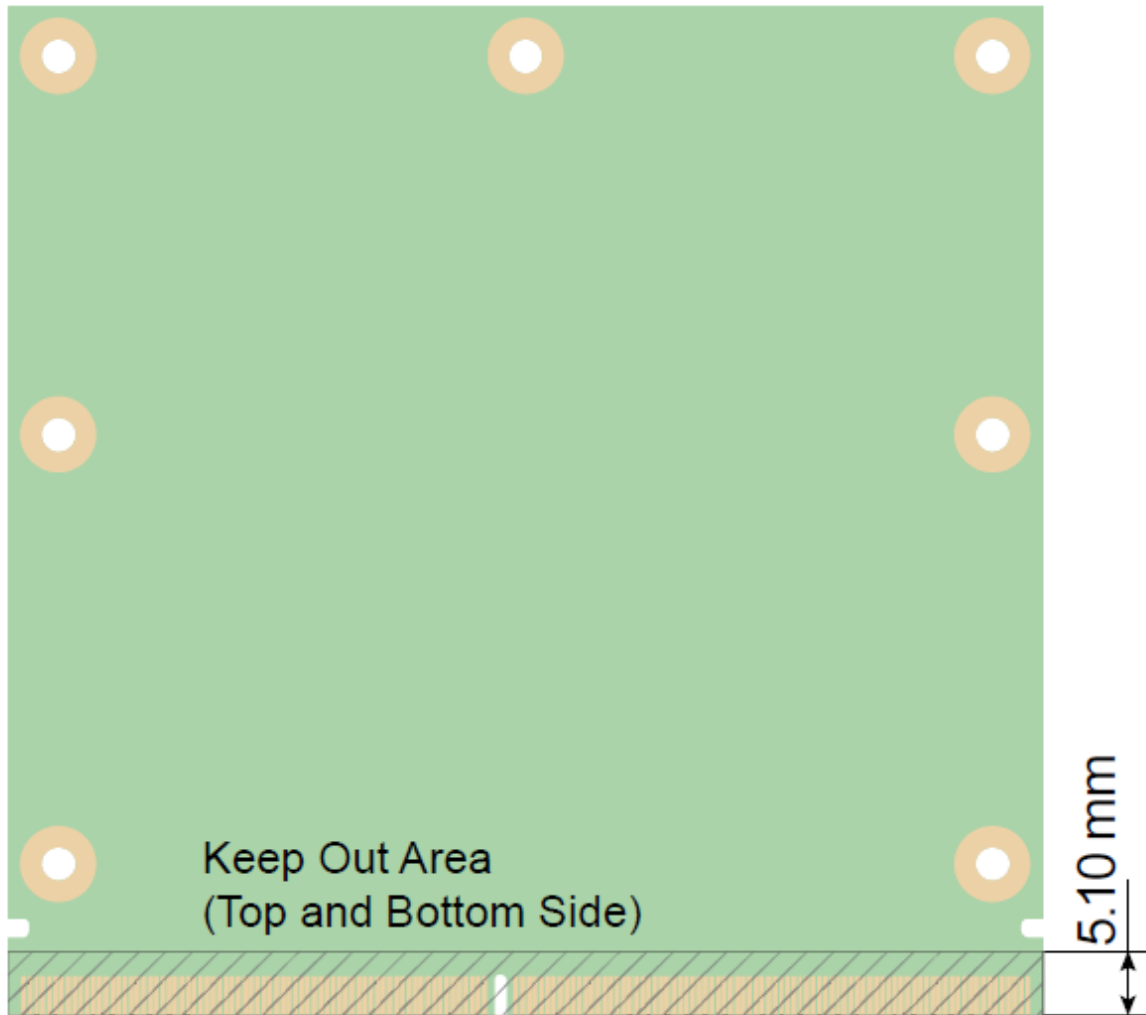
- ▶ Up to 64 GByte pSLC (or 128 GB MLC)
- ▶ eMMC 5.1 specification
- ▶ Class 0 (basic); class 2 (block read); class 4 (block write); class 5 (erase); class 6 (write protection); class 7 (lock card)
- ▶ HS200/HS400 modes
- ▶ DDR modes up to 52 MHz clock speed
- ▶ ECC and block management
- ▶ Boot operation ( High-speed boot)
- ▶ Sleep mode
- ▶ Permanent and power-on write protection
- ▶ Replay-protected memory block (RPMB)
- ▶ Secure erase and secure trim

## 5.4. SMARC Connector

The SMARC connector has different pins on both sides:

- ▶ Top side: 74 pins are on the left side, 82 pins on the right side
- ▶ Bottom side: 75 pins are on the left side, 83 pins on the right side

Figure 9: 314-pin SMARC Connector,



## 5.5. Pinout of SMARC fA3399 Connector

### 5.5.1. Pinout of SMARC fA3399 Topside Connector

Note: Pin Type/Tolerance definition is according to SMARC Specification

Table 8: Pinout of SMARC fA3399 Topside Connector

Pin	Signal	Module Direction	Module Termination	Type/Tolerance	Controller	Power Rail
P1	SMB_ALERT_1V8#	In	NC	-	-	
P2	GND	-	-	-	-	GND
P3	CSI1_CK+	In	-	LVDS D-PHY	RK3399	-
P4	CSI1_CK-	In	-	LVDS D-PHY	RK3399	-
P5	GBE1_SDP	Bi-Dir	NC	-	-	-
P6	GBE0_SDP	Bi-Dir	NC	-	-	-
P7	CSI1_RX0+	In	-	LVDS D-PHY	RK3399	-
P8	CSI1_RX0-	In	-	LVDS D-PHY	RK3399	-
P9	GND	-	-	-	-	GND
P10	CSI1_RX1+	In	-	LVDS D-PHY	RK3399	-
P11	CSI1_RX1-	In	-	LVDS D-PHY	RK3399	-
P12	GND	-	-	-	-	GND
P13	CSI1_RX2+	In	-	LVDS D-PHY	RK3399	-
P14	CSI1_RX2-	In	-	LVDS D-PHY	RK3399	-
P15	GND	-	-	-	-	GND
P16	CSI1_RX3+	In	-	LVDS D-PHY	RK3399	-
P17	CSI1_RX3-	In	-	LVDS D-PHY	RK3399	-
P18	GND	-	-	-	-	GND
P19	GBE0_MDI3-	Bi-Dir	-	GBE MDI	RTL821FI	-
P20	GBE0_MDI3+	Bi-Dir	-	GBE MDI	RTL821FI	-
P21	GBE0_LINK100#	Out/OD	-	CMOS 3.3V	RTL821FI	-
P22	GBE0_LINK1000#	Out/OD	-	CMOS 3.3V	RTL821FI	-
P23	GBE0_MDI2-	Bi-Dir	-	GBE MDI	RTL821FI	-
P24	GBE0_MDI2+	Bi-Dir	-	GBE MDI	RTL821FI	-
P25	GBE0_LINK_ACT#	Out/OD	-	CMOS 3.3V	RTL821FI	-
P26	GBE0_MDI1-	Bi-Dir	-	GBE MDI	RTL821FI	-
P27	GBE0_MDI1+	Bi-Dir	-	GBE MDI	RTL821FI	-
P28	GBE0_CTREF	Out	NC	-	-	-
P29	GBE0_MDI0-	Bi-Dir	-	GBE MDI	RTL821FI	-
P30	GBE0_MDI0+	Bi-Dir	-	GBE MDI	RTL821FI	-
P31	SPIO_CS1#	Out	NC	-	-	-
P32	GND	-	-	-	-	GND
P33	SDIO_WP	In	PU-4k7	CMOS 3.3V	RK3399	V_3V3
P34	SDIO_CMD	Bi-Dir	-	CMOS 3.3V	RK3399	-
P35	SDIO_CD#	In	PU-4k7	CMOS 3.3V	RK3399	V_3V3
P36	SDIO_CK	Out	-	CMOS 3.3V	RK3399	-
P37	SDIO_PWR_EN	Out	-	CMOS 3.3V	RK3399	-
P38	GND	-	-	-	-	GND
P39	SDIO_D0	Bi-Dir	-	CMOS 3.3V	RK3399	-
P40	SDIO_D1	Bi-Dir	-	CMOS 3.3V	RK3399	-
P41	SDIO_D2	Bi-Dir	-	CMOS 3.3V	RK3399	-

Pin	Signal	Module Direction	Module Termination	Type/Tolerance	Controller	Power Rail
P42	SDIO_D3	Bi-Dir	-	CMOS 3.3V	RK3399	-
P43	SPI0_CS0#	Out	-	CMOS 1.8V	RK3399	-
P44	SPI0_CK	Out	-	CMOS 1.8V	RK3399	-
P45	SPI0_DIN	In	-	CMOS 1.8V	RK3399	-
P46	SPI0_DO	Out	-	CMOS 1.8V	RK3399	-
P47	GND	-	-	-	-	GND
P48	SATA_TX+	Out	NC	SATA	-	-
P49	SATA_TX-	Out	NC	SATA	-	-
P50	GND	-	-	-	-	GND
P51	SATA_RX+	In	NC	SATA	-	-
P52	SATA_RX-	In	NC	SATA	-	-
P53	GND	-	-	-	-	GND
P54	ESPI_CS0#	Out	-	CMOS 1.8V	RK3399	-
P55	ESPI_CS1#	Out	NC	-	-	-
P56	ESPI_CK	Out	-	CMOS 1.8V	RK3399	-
P57	ESPI_IO_1	Bi-Dir	-	CMOS 1.8V	RK3399	-
P58	ESPI_IO_0	Bi-Dir	-	CMOS 1.8V	RK3399	-
P59	GND	-	-	-	-	GND
P60	USB0+	Bi-Dir	-	USB	RK3399	-
P61	USB0-	Bi-Dir	-	USB	RK3399	-
P62	USB0_EN_OC#	Bi-Dir OD	PU-10k	CMOS 3.3V	RK3399	V_3V3
P63	USB0_VBUS_DET	In	-	USB VBUS 5V	RK3399	-
P64	USB0_OTG_ID	In	-	CMOS 3.3V	RK3399	-
P65	USB1+	Bi-Dir	-	USB	RK3399	-
P66	USB1-	Bi-Dir	-	USB	RK3399	-
P67	USB1_EN_OC#	Bi-Dir OD	PU-10k	CMOS 3.3V	RK3399	V_3V3
P68	GND	-	-	-	-	GND
P69	USB2+	Bi-Dir	-	USB	RK3399	-
P70	USB2-	Bi-Dir	-	USB	RK3399	-
P71	USB2_EN_OC#	Bi-Dir OD	PU-10k	CMOS 3.3V	RK3399	V_3V3
P72	RSVD	-	NC	-	-	-
P73	RSVD	-	NC	-	-	-
P74	USB3_EN_OC#	Bi-Dir OD	PU-10k	CMOS 3.3V	RK3399	V_3V3
P75	PCIE_A_RST#	Out	-	CMOS 3.3V	RK3399 or PI7C9X2G404SL	-
P76	USB4_EN_OC#	Bi-Dir OD	NC	-	-	-
P77	PCIE_B_CKREQ#	-	PU-10k	-	PI7C9X2G404SL	V_3V3
P78	PCIE_A_CKREQ#	-	PU-10k	-	RK3399 or PI7C9X2G404SL	V_3V3
P79	GND	-	-	-	-	GND
P80	PCIE_C_REFCK+	Out	PD-49R9	LVDS PCIe	PI7C9X2G404SL	-
P81	PCIE_C_REFCK-	Out	PD-49R9	LVDS PCIe	PI7C9X2G404SL	-
P82	GND	-	-	-	-	GND
P83	PCIE_A_REFCK+	Out	-	LVDS PCIe	RK3399 or PI7C9X2G404SL	-
P84	PCIE_A_REFCK-	Out	-	LVDS PCIe	RK3399 or PI7C9X2G404SL	-
P85	GND	-	-	-	-	GND
P86	PCIE_A_RX+	In	Serial-OR	LVDS PCIe	RK3399 or	-

Pin	Signal	Module Direction	Module Termination	Type/Tolerance	Controller	Power Rail
					PI7C9X2G404SL	
P87	PCIE_A_RX-	In	Serial-OR	LVDS PCIe	RK3399 or PI7C9X2G404SL	-
P88	GND	-	-	-	-	GND
P89	PCIE_A_TX+	Out	Serial-100n	LVDS PCIe	Option: iMX8X or PI7C9X2G404SL	-
P90	PCIE_A_TX-	Out	Serial-100n	LVDS PCIe	Option: iMX8X or PI7C9X2G404SL	-
P91	GND	-	-	-	-	GND
P92	HDMI_D2+ /DP1_LANE0+	Out	-	TMDS	RK3399	-
P93	HDMI_D2- /DP1_LANE0-	Out	-	TMDS	RK3399	-
P94	GND	-	-	-	-	GND
P95	HDMI_D1+ /DP1_LANE1+	Out	-	TMDS	RK3399	-
P96	HDMI_D1- /DP1_LANE1-	Out	-	TMDS	RK3399	-
P97	GND	-	-	-	-	GND
P98	HDMI_D0+ /DP1_LANE2+	Out	-	TMDS	RK3399	-
P99	HDMI_D0- /DP1_LANE2-	Out	-	TMDS	RK3399	-
P100	GND	-	-	-	-	GND
P101	HDMI_CK+ /DP1_LANE3+	Out	-	TMDS	RK3399	-
P102	HDMI_CK /DP1_LANE3-	Out	-	TMDS	RK3399	-
P103	GND	-	-	-	-	GND
P104	HDMI_HPD/DP1_HPD	In	PD-1Meg	CMOS 1.8V	RK3399	-
P105	HDMI_CTRL_CK/DP1_AUX+	Bi-Dir	PU-2k2	CMOS 1.8V	RK3399	V_1V8
P106	HDMI_CTRL_DAT/DP1_AUX-	Bi-Dir	PU-2k2	CMOS 1.8V	RK3399	V_1V8
P107	DP1_AUX_SEL	In	NC	CMOS 1.8V	-	-
P108	GPIO0/CAM0_PWR#	Bi-Dir	PU-470k	CMOS 1.8V	RK3399	V_1V8
P109	GPIO1/CAM1_PWR#	Bi-Dir	PU-470k	CMOS 1.8V	RK3399	V_1V8
P110	GPIO2/CAM0_RST#	Bi-Dir	PU-470k	CMOS 1.8V	RK3399	V_1V8
P111	GPIO3/CAM1_RST#	Bi-Dir	PU-470k	CMOS 1.8V	RK3399	V_1V8
P112	GPIO4/HDA_RST#	Bi-Dir	PU-470k	CMOS 1.8V	RK3399	V_1V8
P113	GPIO5/PWM_OUT	Bi-Dir	PU-470k	CMOS 1.8V	RK3399	V_1V8
P114	GPIO6/TACHIN	Bi-Dir	PU-470k	CMOS 1.8V	RK3399	V_1V8
P115	GPIO7	Bi-Dir	PU-470k	CMOS 1.8V	RK3399	V_1V8
P116	GPIO8	Bi-Dir	PU-470k	CMOS 1.8V	RK3399	V_1V8
P117	GPIO9	Bi-Dir	PU-470k	CMOS 1.8V	RK3399	V_1V8
P118	GPIO10	Bi-Dir	PU-470k	CMOS 1.8V	RK3399	V_1V8
P119	GPIO11	Bi-Dir	PU-470k	CMOS 1.8V	RK3399	V_1V8
P120	GND	-	-	-	-	GND
P121	I2C_PM_CK	Bi-Dir	PU-2k2	CMOS 1.8V	RK3399	V_1V8
P122	I2C_PM_DAT	Bi-Dir	PU-2k2	CMOS 1.8V	RK3399	V_1V8
P123	BOOT_SEL0#	In	NC	CMOS 1.8V		V_1V8
P124	BOOT_SEL1#	In	NC	CMOS 1.8V		V_1V8
P125	BOOT_SEL2#	In	NC	CMOS 1.8V		V_1V8

Pin	Signal	Module Direction	Module Termination	Type/Tolerance	Controller	Power Rail
P126	RESET_OUT#	Out -OD	-	CMOS 1.8V	RK3399	-
P127	RESET_IN#	In	PU-10k + Buffer	CMOS 3.3V	Buffer	VCC3V3_SYS
P128	POWER_BTN#	In	PU-10k	CMOS 1.8V	PMIC	-
P129	SER0_TX	Out	-	CMOS 1.8V	RK3399	-
P130	SER0_RX	In	-	CMOS 1.8V	RK3399	-
P131	SER0_RTS#	Out	-	CMOS 1.8V	RK3399	-
P132	SER0_CTS#	In	-	CMOS 1.8V	RK3399	-
P133	GND	-	-	-	-	GND
P134	SER1_TX	Out	-	CMOS 1.8V	RK3399	-
P135	SER1_RX	In	-	CMOS 1.8V	RK3399	-
P136	SER2_TX	Out	NC	CMOS 1.8V	-	-
P137	SER2_RX	In	NC	CMOS 1.8V	-	-
P138	SER2_RTS#	Out	NC	CMOS 1.8V	-	-
P139	SER2_CTS#	In	NC	CMOS 1.8V	-	-
P140	SER3_TX	Out	NC	CMOS 1.8V	-	-
P141	SER3_RX	In	NC	CMOS 1.8V	-	-
P142	GND	-	-	-	-	GND
P143	CAN0_TX	Out	NC	CMOS 1.8V	-	-
P144	CAN0_RX	In	NC	CMOS 1.8V	-	-
P145	CAN1_TX	Out	NC	CMOS 1.8V	-	-
P146	CAN1_RX	In	NC	CMOS 1.8V	-	-
P147	VDD_IN	PWR	-	-	-	3.0V - 5.25V
P148	VDD_IN	PWR	-	-	-	3.0V - 5.25V
P149	VDD_IN	PWR	-	-	-	3.0V - 5.25V
P150	VDD_IN	PWR	-	-	-	3.0V - 5.25V
P151	VDD_IN	PWR	-	-	-	3.0V - 5.25V
P152	VDD_IN	PWR	-	-	-	3.0V - 5.25V
P153	VDD_IN	PWR	-	-	-	3.0V - 5.25V
P154	VDD_IN	PWR	-	-	-	3.0V - 5.25V
P155	VDD_IN	PWR	-	-	-	3.0V - 5.25V
P156	VDD_IN	PWR	-	-	-	3.0V - 5.25V

## 5.5.2. Pinout of SMARC fA3399 Bottom Side Connector

Table 9: Pinout of SMARC fA3399 Bottom Side Connector

Pin	Signal	Module Direction	Module Termination	Type/Tolerance	Controller	Power Rail
S1	CS11_TX+/I2C_CAM1_CLK	Bi-Dir	NC	TMDS/CMOS 1.8V	-	-
S2	CS11_TX-/I2C_CAM1_DAT	Bi-Dir	NC	TMDS/CMOS 1.8V	-	-
S3	GND	-	-	-	-	GND
S4	RSVD	-	NC	-	-	-
S5	CS10_TX+/I2C_CAM0_CLK	Bi-Dir	NC	TMDS/CMOS 1.8V	-	-
S6	CAM_MCK	Out	NC	CMOS 1.8V	-	-
S7	CS10_TX-/I2C_CAM0_DAT	Bi-Dir	NC	TMDS/CMOS 1.8V	-	-
S8	CS10_CLK+	In	-	LVDS D-PHY	RK3399	-



Pin	Signal	Module Direction	Module Termination	Type/Tolerance	Controller	Power Rail
S9	CSIO_CK-	In	-	LVDS D-PHY	RK3399	-
S10	GND	-	-	-	-	GND
S11	CSIO_RX0+	In	-	LVDS D-PHY	RK3399	-
S12	CSIO_RX0-	In	-	LVDS D-PHY	RK3399	-
S13	GND	-	-	-	-	GND
S14	CSIO_RX1+	In	-	LVDS D-PHY	RK3399	-
S15	CSIO_RX1-	In	-	LVDS D-PHY	RK3399	-
S16	GND	-	-	-	-	GND
S17	GBE1_MDI0+	Bi-Dir	-	GBE MDI	I210	-
S18	GBE1_MDI0-	Bi-Dir	-	GBE MDI	I210	-
S19	GBE1_LINK100#	Out/OD	-	CMOS 3.3V	I210	-
S20	GBE1_MDI1+	Bi-Dir	-	GBE MDI	I210	-
S21	GBE1_MDI1-	Bi-Dir	-	GBE MDI	I210	-
S22	GBE1_LINK1000#	Out/OD	-	CMOS 3.3V	I210	-
S23	GBE1_MDI2+	Bi-Dir	-	GBE MDI	I210	-
S24	GBE1_MDI2-	Bi-Dir	-	GBE MDI	I210	-
S25	GND	-	-	-	-	GND
S26	GBE1_MDI3+	Bi-Dir	-	GBE MDI	I210	-
S27	GBE1_MDI3-	Bi-Dir	-	GBE MDI	I210	-
S28	GBE1_CTREF	Out	NC	GBE MDI	-	-
S29	PCIE_D_TX+	Out	NC	LVDS PCIe	-	-
S30	PCIE_D_TX-	Out	NC	LVDS PCIe	-	-
S31	GBE1_LINK_ACT#	Out/OD	-	CMOS 3.3V	I210	-
S32	PCIE_D_RX+	In	NC	LVDS PCIe	-	-
S33	PCIE_D_RX-	In	NC	LVDS PCIe	-	-
S34	GND	-	-	-	-	GND
S35	USB4+	Bi-Dir	NC	USB	-	-
S36	USB4-	Bi-Dir	NC	USB	-	-
S37	USB3_VBUS_DET	In	NC	USB VBUS 5V	-	-
S38	AUDIO_MCK	Out	Serial 22R	CMOS 1.8V	RK3399	-
S39	I2S0_LRCK	Bi-Dir	Serial 22R	CMOS 1.8V	RK3399	-
S40	I2S0_SDOOUT	Out	Serial 22R	CMOS 1.8V	RK3399	-
S41	I2S0_SDIN	In	Serial 22R	CMOS 1.8V	RK3399	-
S42	I2S0_CK	Bi-Dir	Serial 22R	CMOS 1.8V	RK3399	-
S43	ESPI_ALERT0#	In	NC	CMOS 1.8V	-	-
S44	ESPI_ALERT1#	In	NC	CMOS 1.8V	-	-
S45	RSVD	-	NC	-	-	-
S46	RSVD	-	NC	-	-	-
S47	GND	-	-	-	-	GND
S48	I2C_GP_CK	Out	PU-2k2	CMOS 1.8V	RK3399	V_1V8
S49	I2C_GP_DAT	Bi-Dir	PU-2k2	CMOS 1.8V	RK3399	V_1V8
S50	HDA_SYNC/I2S2_LRCK	Bi-Dir	Serial 22R	CMOS 1.5V/1.8V	RK3399	-
S51	HDA_SDO/I2S2_SDOOUT	Out	Serial 22R	CMOS 1.5V/1.8V	RK3399	-
S52	HDA_SDI/I2S2_SDIN	In	Serial 22R	CMOS 1.5V/1.8V	RK3399	-
S53	HDA_CK/I2S2_CK	Bi-Dir	Serial 22R	CMOS 1.5V/1.8V	RK3399	-

Pin	Signal	Module Direction	Module Termination	Type/Tolerance	Controller	Power Rail
S54	SATA_ACT#	Out/OD	NC	CMOS 3.3V	-	-
S55	USB5_EN_OC#	Bi-Dir OD	NC	CMOS 3.3V	-	-
S56	ESPI_IO_2	Bi-Dir	NC	CMOS 1.8V	-	-
S57	ESPI_IO_3	Bi-Dir	NC	CMOS 1.8V	-	-
S58	ESPI_RESET#	Out	NC	CMOS 1.8V	-	-
S59	USB5+	Bi-Dir	NC	USB	-	-
S60	USB5-	Bi-Dir	NC	USB	-	-
S61	GND	-	-	-	-	GND
S62	USB3_SSTX+	Out	NC	USB SS	-	-
S63	USB3_SSTX-	Out	NC	USB SS	-	-
S64	GND	-	-	-	-	GND
S65	USB3_SSRX+	In	NC	USB SS	-	-
S66	USB3_SSRX-	In	NC	USB SS	-	-
S67	GND	-	-	-	-	GND
S68	USB3+	Bi-Dir	-	USB	RK3399	-
S69	USB3-	Bi-Dir	-	USB	RK3399	-
S70	GND	-	-	-	-	GND
S71	USB2_SSTX+	Out	Serial-100n	USB SS	RK3399	-
S72	USB2_SSTX-	Out	Serial-100n	USB SS	RK3399	-
S73	GND	-	-	-	-	GND
S74	USB2_SSRX+	In	-	USB SS	RK3399	-
S75	USB2_SSRX-	In	-	USB SS	RK3399	-
S76	PCIE_B_RST#	Out	-	CMOS 3.3V	PI7C9X2G4045L	-
S77	PCIE_C_RST#	Out	-	CMOS 3.3V	PI7C9X2G4045L	-
S78	PCIE_C_RX+	In	-	LVDS PCIe	PI7C9X2G4045L or NC	-
S79	PCIE_C_RX-	In	-	LVDS PCIe	PI7C9X2G4045L or NC	-
S80	GND	-	-	-	-	GND
S81	PCIE_C_TX+	Out	Serial-100n or NC	LVDS PCIe	PI7C9X2G4045L or NC	-
S82	PCIE_C_TX-	Out	Serial-100n or NC	LVDS PCIe	PI7C9X2G4045L or NC	-
S83	GND	-	-	-	-	GND
S84	PCIE_B_REFCK+	Out	PD-49R9 or NC	LVDS PCIe	PI7C9X2G4045L or NC	-
S85	PCIE_B_REFCK-	Out	PD-49R9 or NC	LVDS PCIe	PI7C9X2G4045L or NC	-
S86	GND	-	-	-	-	GND
S87	PCIE_B_RX+	In	-	LVDS PCIe	PI7C9X2G4045L or NC	-
S88	PCIE_B_RX-	In	-	LVDS PCIe	PI7C9X2G4045L or NC	-
S89	GND	-	-	-	-	GND
S90	PCIE_B_TX+	Out	Serial-100n or NC	LVDS PCIe	PI7C9X2G4045L or NC	-
S91	PCIE_B_TX-	Out	Serial-100n or NC	LVDS PCIe	PI7C9X2G4045L or NC	-
S92	GND	-	-	-	-	GND
S93	DPO_LANE0+	Out	-	LVDS PCIe	RK3399	-
S94	DPO_LANE0-	Out	-	LVDS PCIe	RK3399	-
S95	DPO_AUX_SEL	In	NC	CMOS 1.8V	-	-

Pin	Signal	Module Direction	Module Termination	Type/Tolerance	Controller	Power Rail
S96	DPO_LANE1+	Out	-	LVDS PCIE	RK3399	-
S97	DPO_LANE1-	Out	-	LVDS PCIE	RK3399	-
S98	DPO_HPD	In	PD-1Meg	CMOS 1.8V	RK3399	-
S99	DPO_LANE2+	Out	-	LVDS PCIE	RK3399	-
S100	DPO_LANE2-	Out	-	LVDS PCIE	RK3399	-
S101	GND	-	-	-	-	GND
S102	DPO_LANE3+	Out	-	LVDS PCIE	RK3399	-
S103	DPO_LANE3-	Out	-	LVDS PCIE	RK3399	-
S104	USB3_OTG_ID	In	NC	CMOS 3.3V	NC	-
S105	DPO_AUX+	Bi-Dir	Serial-100n PD-100k	LVDS PCIE	RK3399	-
S106	DPO_AUX-	Bi-Dir	Serial-100n PU-100k	LVDS PCIE	RK3399	-
S107	LCD1_BKLT_EN	Out	NC	CMOS 1.8V	-	-
S108	LVDS1_CK+/eDP1_AUX+/DSI1_CLK+	Out	-	LVDS LCD	TC358775XBG	-
S109	LVDS1_CK-/eDP1_AUX-/DSI1_CLK-	Out	-	LVDS LCD	TC358775XBG	-
S110	GND	-	-	-	-	GND
S111	LVDS1_0+/EDP1_TX0+/DSI1_D0+	Out	-	LVDS LCD	TC358775XBG	-
S112	LVDS1_0-/EDP1_TX0-/DSI1_D0-	Out	-	LVDS LCD	TC358775XBG	-
S113	eDP1_HPD	In	NC	CMOS 1.8V	NC	-
S114	LVDS1_1+/EDP1_TX1+/DSI1_D1+	Out	-	LVDS LCD	TC358775XBG	-
S115	LVDS1_1-/EDP1_TX1-/DSI1_D1-	Out	-	LVDS LCD	TC358775XBG	-
S116	LCD1_VDD_EN	Out	NC	CMOS 1.8V	-	-
S117	LVDS1_2+/eDP1_TX2+/DSI1_D2+	Out	-	LVDS LCD	TC358775XBG	-
S118	LVDS1_2-/eDP1_TX2-/DSI1_D2-	Out	-	LVDS LCD	TC358775XBG	-
S119	GND	-	-	-	-	GND
S120	LVDS1_3+/eDP1_TX3+/DSI1_D3+	Out	-	LVDS LCD	TC358775XBG	-
S121	LVDS1_3-/eDP1_TX3-/DSI1_D3-	Out	-	LVDS LCD	TC358775XBG	-
S122	LCD1_BKLT_PWM	Out	NC	CMOS 1.8V	-	-
S123	GPIO13	-	NC	-	-	-
S124	GND	-	-	-	-	GND
S125	LVDS0_0+/eDPO_TX0+/DSI0_D0+	Out	-	LVDS LCD	TC358775XBG	-
S126	LVDS0_0-/eDPO_TX0-/DSI0_D0-	Out	-	LVDS LCD	TC358775XBG	-
S127	LCDO_BKLT_EN	Out	-	CMOS 1.8V	RK3399	-
S128	LVDS0_1+/eDPO_TX1+/DSI0_D1+	Out	-	LVDS LCD	TC358775XBG	-
S129	LVDS0_1-/eDPO_TX1-/DSI0_D1-	Out	-	LVDS LCD	TC358775XBG	-

Pin	Signal	Module Direction	Module Termination	Type/Tolerance	Controller	Power Rail
S130	GND	-	-	-	-	GND
S131	LVDS0_2+/eDP0_TX2+/DSIO_D2+	Out	-	LVDS LCD	TC358775XBG	-
S132	LVDS0_2-/eDP0_TX2-/DSIO_D2-	Out	-	LVDS LCD	TC358775XBG	-
S133	LCD0_VDD_EN	Out	-	CMOS 1.8V	RK3399	-
S134	LVDS0_CK+/eDP0_AUX+/DSIO_CLK+	Out	-	LVDS LCD	TC358775XBG	-
S135	LVDS0_CK-/eDP0_AUX-/DSIO_CLK-	Out	-	LVDS LCD	TC358775XBG	-
S136	GND	-	-	-	-	GND
S137	LVDS0_3+/eDP0_TX3+/DSIO_D3+	Out	-	LVDS LCD	TC358775XBG	-
S138	LVDS0_3-/eDP0_TX3-/DSIO_D3-	Out	-	LVDS LCD	TC358775XBG	-
S139	I2C_LCD_CK	Out	NC	CMOS 1.8V	-	-
S140	I2C_LCD_DAT	Bi-Dir	NC	CMOS 1.8V	-	-
S141	LCD0_BKLT_PWM	Out	-	CMOS 1.8V	RK3399	-
S142	GPIO12	-	NC	-	-	-
S143	GND	-	-	-	-	GND
S144	EDPO_HPDP	In	PD-1Meg	CMOS 1.8V	RK3399	-
S145	WDT_TIME_OUT#	Out	-	CMOS 1.8V	RK3399	-
S146	PCIE_WAKE#	In	-	CMOS 3.3V	RK3399	V_3V3
S147	VDD_RTC	-	Diode and Measurement circuit	PWR	PMIC	V_3V3_RTC (2.0V-3.25V)
S148	LID#	In	NC	CMOS 1.8V	-	-
S149	SLEEP#	In	PU-10k	CMOS 1.8V	RK3399	V_1V8_SCU
S150	VIN_PWR_BAD#	In	PU-10k	CMOS VDD_IN	RK3399	Input power V_3V0-5V25_IN
S151	CHARGING#	In	NC	CMOS 1.8V	-	-
S152	CHARGER_PRSENT#	In	NC	CMOS 1.8V	-	-
S153	CARRIER_STBY#	Out	PU-10k	CMOS 1.8V	RK3399	V_1V8
S154	CARRIER_PWR_ON	Out	PU-10k	CMOS 1.8V	RK3399	V_1V8
S155	FORCE_RECOV#	In	PU-10k	CMOS 1.8V	RK3399	V_1V8_SCU
S156	BATLOW#	In	PU_10k	CMOS 1.8V	RK3399	V_1V8
S157	TEST#	In	NC	CMOS 1.8V	NC	-
S158	GND	-	-	-	-	GND

## 6/ Installation

### 6.1. Boot Process

On power-on, the module searches u-boot image on following storage devices in this order:

1. Module QSPI NOR flash
2. Carrier SD card

If no valid u-boot image is found, the boot process then jumps into Serial Download Mode where it waits for mfgtool commands over USB2 OTG. When FORCE\_RECOV# is pulled down, the boot process jumps directly into Serial Download Mode without looking for a valid boot image.

Carrier BOOT\_SEL pins (BOOT\_SELO#, BOOT\_SEL1# and BOOT\_SEL2#) are available as GPIO inputs in u-boot. These inputs can be used to customize boot process via u-boot macros.

### 6.2. PCIe Switch options

There are four different configurations available to configure the PCI switch:

#### Configuration 1 (default)

- ▶ Second Ethernet on ETH1
- ▶ 1 x PCIe to LAN Controller via PCIe SW
- ▶ 2x PCIe at SMARC connector via PCIe SW (PCIeA + PCIeB)
- ▶ PCIe Switch and LAN Controller

#### Configuration 2

- ▶ No ETH1
- ▶ 1x PCIe A on SMARC connector directly from i.MX8 CPU
- ▶ Without PCIe Switch and LAN Controller

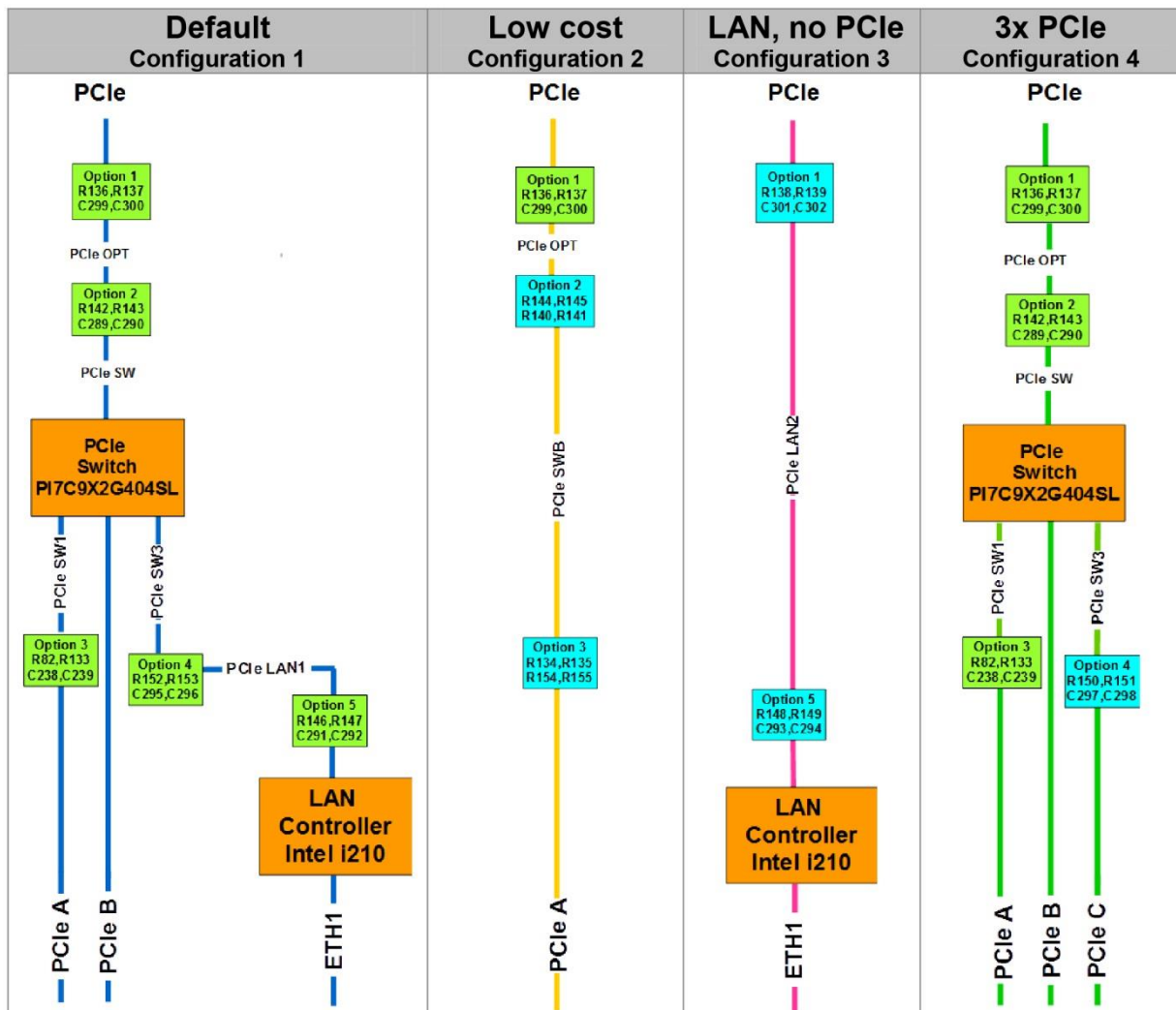
#### Configuration 3

- ▶ LAN Controller directly connected to PCIe from CPU
- ▶ No PCIe on SMARC connector
- ▶ Without PCIe Switch

#### Configuration 4

- ▶ No ETH1
- ▶ 3x PCIe at SMARC connector via PCIe SW (PCIe A, PCIe B, PCIe C)
- ▶ PCIe Switch without LAN Controller

Figure 10: PCI Switch Configuration



NOTE: one LAN port (ETH0) is permanently available for all configuration thru GbE PHY (U20).

### 6.3. Configurable Watchdog

As no CPLD is available, the Watchdog must be used from the SoC. The WDOG features are listed below:

- Three Watchdogs in SoC with 32 bits counter width
- Counter clock is from APB bus clock
- Counter counts down from a preset value to 0 to indicate the occurrence of a timeout
- WDT can perform two types of operations when timeout occurs:
  - Generate a system reset
  - First generate an interrupt and if this is not cleared by the service routine by the time a second timeout occurs then generate a system reset
- Programmable reset pulse length
- Totally 16 defined-ranges of main timeout period

## 6.4. UART Interfaces

Use following UART interfaces with control signals of i.MX8X.

**Table 10: Mapping of SMARC SER interfaces to i.MX8X UARTs**

SER	UART	Function
SER0	UART0	Standard
SER1	UART2C	Debug
SER2	NC	
SER3	NC	

## 6.5. Power Control

### 6.5.1. Power Supply

The SMARC-fA3399 supports a power input from 4.75 to 5.25V. The supply voltage is applied through the VCC pins (VCC) of the module connector. Considered current rating of protective device is part of End-Equipment.




---

The following parameters should be delivered from the carrier board:

- ▶ Voltage Ripple maximum 100 mV peak to peak 0-20 MHz in 0 ms to 20 ms rise time from input voltage <10% to nominal VCC
  - ▶ Max allowed inrush current: connector limit (15 W @ 3,0 V)
- 

### 6.5.2. Power Button (POWER\_BTN#)

The power button (Pin P128) is available through the module connector described in the pinout list. To start the module via Power Button the PWRBTN# signal must be at least 50 ms ( $50 \text{ ms} \leq t < 4 \text{ s}$ , typical 400 ms) at low level (Power Button Event).




---

Pressing the power button for at least 4 seconds will turn off power to the module (Power Button Override).

---

### 6.5.3. Power Bad Signal (VIN\_POWER\_BAD#)

The SMARC-fA3399 provides an external input for a Carrier Board Power Bad signal (Pin S150). The implementation of this subsystem complies with the SMARC Specification. VIN\_POWER\_BAD# is internally pulled up to module input voltage and must be high level (open drain) to power on the module.

### 6.5.4. Reset Button (RESET\_IN#)

The reset button (Pin P127) is available through the module connector described in the pinout list. The module will stay in reset as long as RESET\_IN# is grounded.

#### **NOTICE**

---

If any of the supply voltages drops below the allowed operating level longer than the specified hold-up time, all the supply voltages should be shut down and left OFF for a time long enough to allow the internal board voltages to discharge sufficiently.

If the OFF time is not observed, parts of the board or attached peripherals may work incorrectly or even suffer a reduction of MTBF.

The minimum OFF time depends on the implemented PSU model and other electrical factors and needs to be measured individually for each case.

---



## 7/ Bootloader Operation

### 7.1. Copyrights and Licensing of U-Boot

U-Boot is free Software. It is copyrighted by Wolfgang Denk and many others who contributed code. U-Boot can be redistributed and modified under the terms of version 2 of the GNU General Public (GPL V2) License as published by the Free Software Foundation.

Actual source code of mainline U-Boot and authors of the source can be obtained from the git repository at

- ▶ [git://git.denx.de/u-boot.git](https://git.denx.de/u-boot.git)

SMARC-fA3399 bootloader sources are derived work from a dedicated version of mainline U-Boot, e.g v2017.03. As bootloader evolves, the root of the derived work might change to a later version.

### 7.2. Bootloader Quickstart

The SMARC-fA3399 board comes with U-Boot preinstalled on the QSPI flash device. Follow the steps below to gain access to the bootloader command line (CLI) on your host PC.

- ▶ Connect your host machine to the carrier port connected with the edge connector SER1 port of the module. On Kontron SMARC 2.0 carrier this port is named SER\_1.
- ▶ Start a suitable terminal program on your host and attach it to the port connected with the board's serial interface. Configure the serial line using **115200 baud, 8 data bits, 1 stop bit, no parity**.
- ▶ Connect power supply to the carrier and power up.
- ▶ When boot messages appear, press any key to stop automatic boot sequence.

After power on, bootloader boot messages will appear as shown below. There is a 0 second boot delay counter that will try to boot linux OS automatically after expiration. Pressing any key will stop the boot delay counter and enter the bootloader CLI

```

Model: Rockchip RK3399 KON-6004 Board (Linux Opensource)
Rockchip UBOOT DRM driver version: v1.0.1
Using display timing dts
Detailed mode clock 148500 kHz, flags[a]
  H: 1920 2080 2100 2200
  V: 1080 1090 1100 1125
bus_format: 100e
final DSI-Link bandwidth: 992 Mbps x 4
rockchip_dsi_external_bridge_power_on
CLK: (uboot. arml: enter 816000 KHz, init 816000 KHz, kernel ON/A)
CLK: (uboot. armb: enter 24000 KHz, init 24000 KHz, kernel ON/A)
  ap1l1 816000 KHz
  ap1l2 24000 KHz
  dp1l 856000 KHz
  cp1l 148000 KHz
  gp1l 800000 KHz
  np1l 600000 KHz
  vp1l 24000 KHz
  aclk_perihp 133333 KHz
  hclk_perihp 66666 KHz
  pclk_perihp 33333 KHz
  aclk_perilp0 266666 KHz
  hclk_perilp0 88888 KHz
  pclk_perilp0 44444 KHz
  hclk_perilp1 100000 KHz
  pclk_perilp1 50000 KHz
Net:   eth0: ethernet@fe300000
0xff720000 = 0x806
0xff720004 = 0xe04

```

```
0xff730000 = 0x1d02000  
0xff790000 = 0x1c000000  
Hit key to stop autoboot('CTRL+C'): 0
```

## 7.3. Bootloader Commands

The bootloader CLI provides a bunch of powerful commands to control the board, which basically can be grouped into

- ▶ Information Commands
- ▶ Memory Commands
- ▶ Flash Memory Commands
- ▶ Execution Control Commands
- ▶ Download Commands
- ▶ Environment Control Commands
- ▶ Flattened Device Tree Support Commands
- ▶ Storage Device Control Commands
- ▶ File System Support Commands
- ▶ Kontron Command Extensions




---

Typing "help" at the bootloader command line prompt will show up a list of the commands available. Typing "help <command>" will show specific command help. Further help can be found under <https://www.denx.de/wiki/view/DULG/UBoot>

---

On the SMARC-fA3399 bootloader, the powerful hush shell is enabled, which is similar to Bourne shell and provides features similar to a linux shell:

- ▶ Control structures (if ... then ... else ... fi etc.)
- ▶ Command line completion
- ▶ Command line editing
- ▶ Command line history up to 20 entries
- ▶ Local environment variables

## 7.4. Bootloader Environment

The bootloader environment is used to control bootloader and OS startup behavior. Environment variables can be used to control boot timing (e.g. bootdelay), interface properties (e.g. baudrate, ethact) or they define memory locations where OS images are stored before boot (e.g. loadaddr, fdt\_addr). In addition, bootloader shell commands can be combined to environment scripts.

The redundant bootloader environment is permanently stored in the QSPI flash device at offset 0x0C0000 and 0x0C8000. During bootloader operation, the environment is held in RAM memory and can be modified and written back to persistent storage.

Bootloader commands to modify the environment are summed up under the "env" command group:

- ▶ env default [-f] -a [forcibly] reset default environment
- ▶ env default [-f] var [...] [forcibly] reset variable(s) to their default values
- ▶ env delete [-f] var [...] [forcibly] delete variable(s)
- ▶ env edit name edit environment variable
- ▶ env exists name tests for existence of variable
- ▶ env print [-a | name ...] print environment
- ▶ env run var [...] run commands in an environment variable
- ▶ env save save environment
- ▶ env set [-f] name [arg ...]

However, the legacy commands for environment handling are still available:

- ▶ "setenv",
- ▶ "editenv",
- ▶ "printenv"
- ▶ "saveenv".

U-Boot standard environment variables are set up for the SMARC-fA3399 module as shown below.

**Table 11: Standard Environment Variables**

Variable	Value	Description
baudrate	115200	Serial line baudrate
bootcmd	Run mmcboot    run sdboot    run usbboot    run netboot    run bootfailed	Try booting (in this order) from eMMC, SD card, USB, network
bootdelay	3	Wait 3 seconds before executing bootcmd
ethprime	FEC0	Use Ethernet port FEC0 as default
loadaddr	0x80800000	Default memory location for OS boot

A typical user modification would be to set the variable "bootcmd" to change OS boot commands.

## 7.5. Bootloader Mass Storage Support

U-Boot provides support to read and write from mass storage devices like

- ▶ eMMC device
- ▶ SD card
- ▶ USB thumb device

Usb

### 7.5.1. SD Card and eMMC Devices

eMMC and SD card are accessed using the "mmc" command

**Example:** Load 256 blocks from eMMC/print

```
=> mmc dev 1
=> mmc read ${loadaddr} 0 100
```

### 7.5.2. USB Storage Device

lsUSB storage devices are accessed using "usb" command

**Example:** Load bootloader update file from USB thumb device

```
=> usb start
=> usb dev 0
=> fatload usb 0:1 update_sMX8X_spl/u-boot-sMX8X_spl.bin
```

## 7.6. Bootloader Network Support

U-Boot provides support for GBE0 Ethernet interface. GBE1 is not supported in Uboot.

Board specific MAC addresses are read from EEPROM during startup and environment variables are set automatically. In case EEPROM contents is missing or corrupted, a "random" MAC address will be set to "ethaddr"

In case that the current network interface is attached to a network providing a DHCP server, an IP address can be gathered using "bootp" or "dhcp" commands.

After that, a file from a tftp server can be copied to memory using the "tftpboot" command.

### Example:

```
=> bootp
=> tftpboot ${loadaddr} <filename>
```

## 8/ Software Update

### 8.1. Updating the software image

#### 8.1.1. You need:

- ▶ SMARC-fA3399 running on SMARC Evaluation Carrier 2.0
- ▶ Computer, running Windows 10
- ▶  $\mu$ USB cable
- ▶ serial cable or USB2RS232, when Computer has no COM port

## 8.1.2. Preparing the hardware

- ▶ Connect  $\mu$ USB cable from SMARC Evaluation Carrier 2.0 to Windows PC (blue arrow)
- ▶ Connect serial cable from SMARC Evaluation Carrier 2.0 to Windows PC (yellow arrow)
- ▶ Short F.REC jumper on SMARC Evaluation Carrier 2.0

Figure 11: Hardware for Software Updates

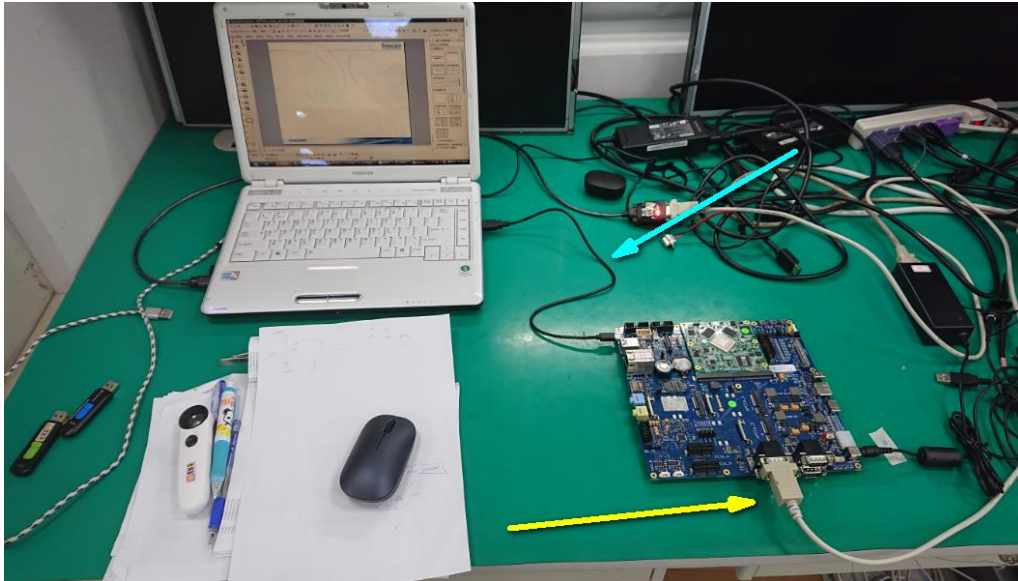
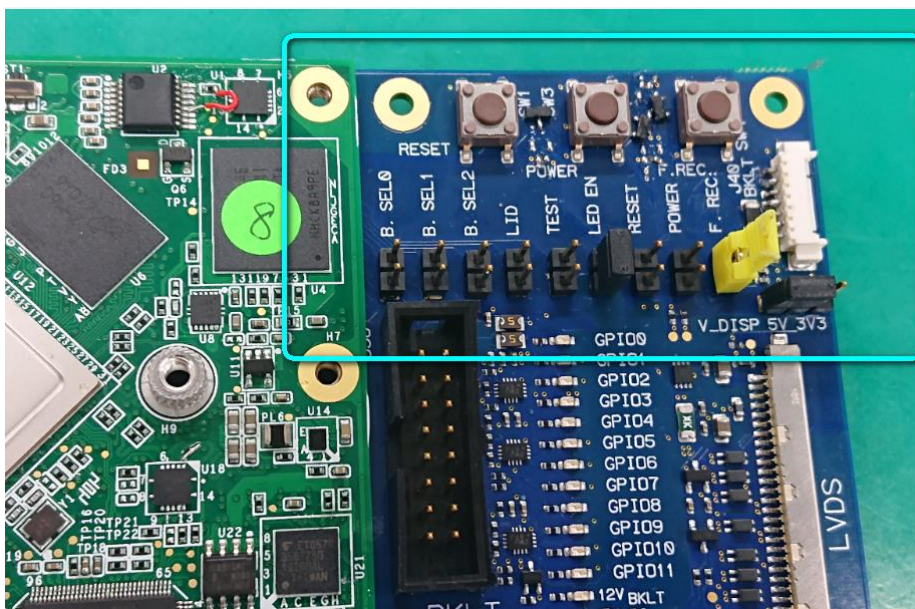


Figure 12: Jumper on Evaluation Carrier



### 8.1.3. Preparing the software and uploading image

- ▶ Download "Driver Assistant" from [https://emdcustomersection.kontron.com/?page\\_id=2746](https://emdcustomersection.kontron.com/?page_id=2746) and extract and install on the windows machine
- ▶ Download "Android Tool" from [https://emdcustomersection.kontron.com/?page\\_id=2746](https://emdcustomersection.kontron.com/?page_id=2746) and extract on windows machine
- ▶ Run "Android Tool" as Administrator

Figure 13: Software Tool





## 9/ Technical Support

For technical support contact our Support department:

E-mail: [support@kontron.com](mailto:support@kontron.com)

Phone: +49-821-4086-888

Make sure you have the following information available when you call:

Product ID Number (PN),

Serial Number (SN)




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The serial number can be found on the Type Label, located on the product's rear side.

---

Be ready to explain the nature of your problem to the service technician.

### 9.1. Warranty

Due to their limited service life, parts that by their nature are subject to a particularly high degree of wear (wearing parts) are excluded from the warranty beyond that provided by law. This applies to the CMOS battery, for example.




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If there is a protection label on your product, then the warranty is lost if the product is opened.

---

### 9.2. Returning Defective Merchandise

All equipment returned to Kontron must have a Return of Material Authorization (RMA) number assigned exclusively by Kontron. Kontron cannot be held responsible for any loss or damage caused to the equipment received without an RMA number. The buyer accepts responsibility for all freight charges for the return of goods to Kontron's designated facility. Kontron will pay the return freight charges back to the buyer's location in the event that the equipment is repaired or replaced within the stipulated warranty period. Follow these steps before returning any product to Kontron.

1. Visit the RMA Information website:  
<http://www.kontron.com/support-and-services/support/rma-information>

Download the RMA Request sheet for Kontron Europe GmbH and fill out the form. Take care to include a short detailed description of the observed problem or failure and to include the product identification Information (Name of product, Product number and Serial number). If a delivery includes more than one product, fill out the above information in the RMA Request form for each product.

2. Send the completed RMA-Request form to the fax or email address given below at Kontron Europe GmbH. Kontron will provide an RMA-Number.

Kontron Europe GmbH  
RMA Support  
Phone: +49 (0) 821 4086-0  
Fax: +49 (0) 821 4086 111  
Email: [service@kontron.com](mailto:service@kontron.com)

3. The goods for repair must be packed properly for shipping, considering shock and ESD protection.



---

Goods returned to Kontron Europe GmbH in non-proper packaging will be considered as customer caused faults and cannot be accepted as warranty repairs.

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4. Include the RMA-Number with the shipping paperwork and send the product to the delivery address provided in the RMA form or received from Kontron RMA Support.

## List of Acronyms


CPLD	Complex Programmable Logic Devices
CSI	Camera Serial Interface
DTE	Data Terminal Equipment
DSI	Display Serial Interface
DCE	Data Communications Equipment
eCSPI	enhanced Configurable Synchronous Programmable serial Interface
eCSPI	enhanced Configurable Synchronous Programmable serial Interface
eDP	embedded Display Port
EMC	Electromagnetic Compatibility
EMI	Electromagnetic Interference
eMMC	embedded Multimedia Card
EPDC	Electronic Paper Display Controller
ESD	Electrostatic Discharge
GPIO	General-purpose input/output
HDA	High Definition Audio
I2S	Inter-IC Sound
KPP	Key Pad Port
LPDDR	Low Power DDR
LVDS	Low Voltage Differential Signalling
MIPI	Mobile Industry Processor Interface
MLC	Multi-level Cell
pSLC	pseudo Single Level Cell
SDIO	Secure Digital Input Output
SMARC	Smart Mobility ARChitecture
SMBus	System Management Bus
SoC	System on Chip
TPM	Trusted Platform Module
UART	Universal Asynchronous Receiver Transmitter



## About Kontron

Kontron is a global leader in Embedded Computing Technology (ECT). As a part of technology group S&T, Kontron offers a combined portfolio of secure hardware, middleware and services for Internet of Things (IoT) and Industry 4.0 applications. With its standard products and tailor-made solutions based on highly reliable state-of-the-art embedded technologies, Kontron provides secure and innovative applications for a variety of industries. As a result, customers benefit from accelerated time-to-market, reduced total cost of ownership, product longevity and the best fully integrated applications overall. For more information, please visit: <http://www.kontron.com/>

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