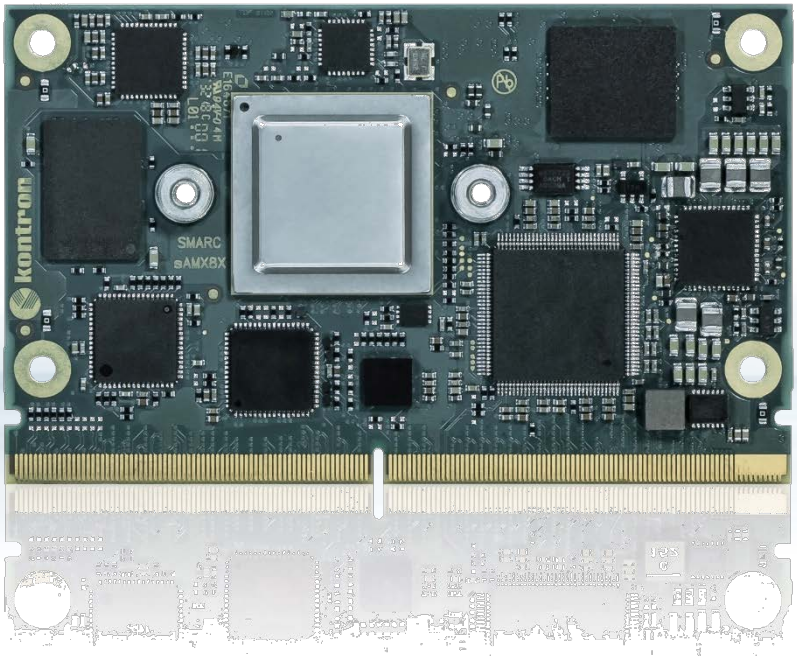
USER GUIDE



SMARC-sAMX8X

User Guide Rev. 1.7

Doc-ID: 1064-5181

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SMARC-SAMX8X - USER GUIDE

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⚠CAUTION

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" supplied with the system.

NOTICE

You find the most recent version of the "General Safety Instructions" online in the download area of this product.

Revision History

Revision	Brief Description of Changes	Date of Issue	Author
1.0	Initial Issue	2020-January-08	hjs
1.1	Chapter 6.1 updated	2020-April-01	hjs
1.2	HDMI removed	2020-October-06	hjs
1.3	Wibu option added, address changed, SER2 issue in chapter 7.2 modified	2021-January-14	hjs
1.4	EN62368 notice in chapter 6.6.1 added	2021-February-24	hjs
1.5	Word2016 issues, updated memory up to 4 GB RAM	2021-April-06	hjs
1.6	EN55032 and UL62368 updated in Table 4	2021-April-14	hjs
1.7	Correct Figure 4, SPI flash numbering	2023-Oct-10	CW

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For contact information, refer to the corporate offices contact information on the last page of this user guide or visit our website CONTACT US.

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Find Kontron contacts by visiting: https://www.kontron.de/support-and-services.

Customer Service

As a trusted technology innovator and global solutions provider, Kontron extends its embedded market strengths into a services portfolio allowing companies to break the barriers of traditional product lifecycles. Proven product expertise coupled with collaborative and highly-experienced support enables Kontron to provide exceptional peace of mind to build and maintain successful products.

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Customer Comments

If you have any difficulties using this user guide, discover an error, or just want to provide some feedback, contact Kontron support. Detail any errors you find. We will correct the errors or problems as soon as possible and post the revised user guide on our website.

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.
NOTICE	NOTICE indicates a property damage message.
⚠CAUTION	CAUTION indicates a hazardous situation which, if not avoided, may result in minor or moderate injury.
	Electric Shock! This symbol and title warn of hazards due to electrical shocks (> 60 V) when touching products or parts of products. 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.
	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.
	Laser! This symbol inform of the risk of exposure to laser beam and light emitting devices (LEDs) from an electrical device. Eye protection per manufacturer notice shall review before servicing.
	This symbol indicates general information about the product and the user guide. 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.

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

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

Table of Contents

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1/ Introduction

This manual describes the Smart Mobility ARChitecture (SMARC) sAMX8X (SMX8) board. The Advanced RISC Machines (ARM) based module is equipped with the NXP i.MX8X processors 8DualX, 8DualXPlus, 8QuadXPlus. The dual or quad core SoC shall be the successor of the SMARC-sAMX7i module and there be as versatile as the existing module and provide similar characteristics with better price/performance/power/lifetime ratio.

The use of this Users Guide implies a basic knowledge of PC hard- and software. This manual is focussed 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.

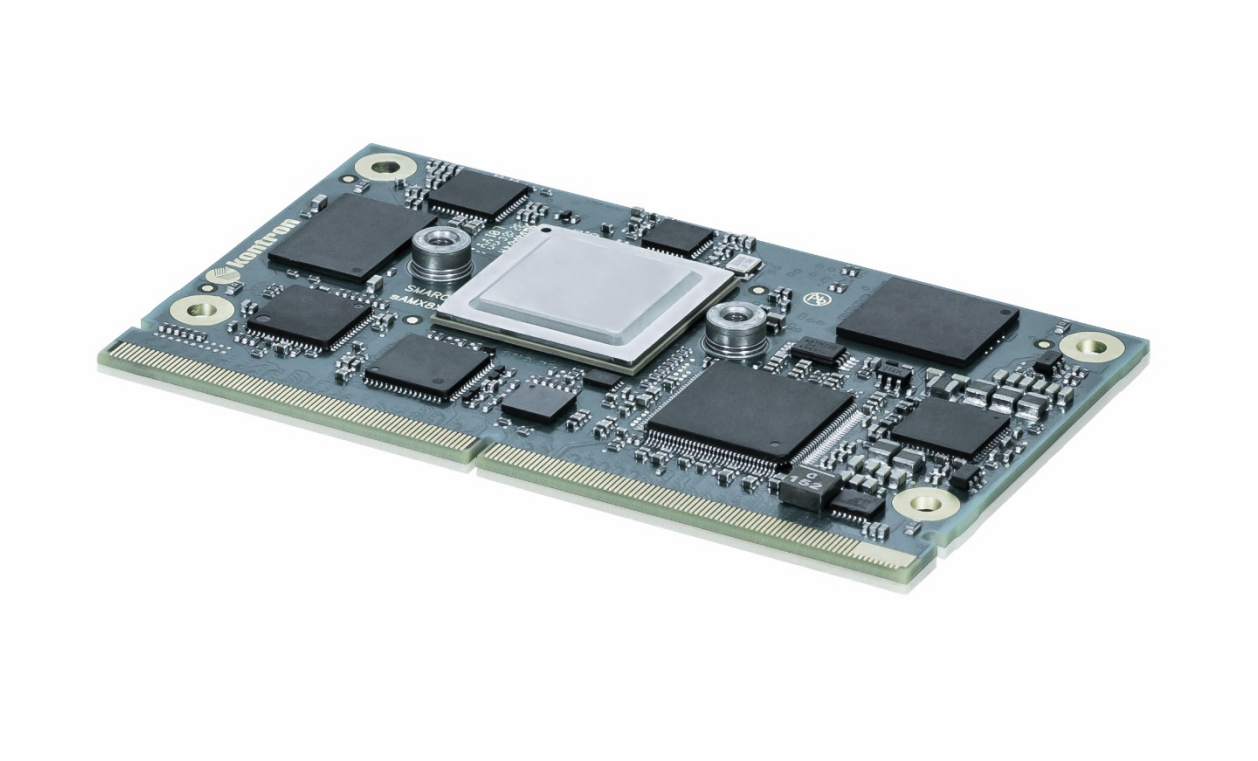
All configuration and setup of the CPU board is either done automatically or manually by the user via the BIOS setup menus.

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-sAMX8X is a SMARC half-size module using the NXPs i.MX8X processor with either dual or quad core ARM. It is designed on the latest SMARC 2.0 specification. The SMARC-sAMX8X is a highly integrated, embedded computer board.

Figure 1: Half-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-sAMX8X are:

- Dual/Quad-Core Cortex A-35 with additional M4 Core on SMARC short size form factor
- Based on i.MX8X Series from NXP – three Pin compatible, scalable SKUs (2x dual, one quad-core; 1.5 W to 5.5 W target TDP)
- Up to 4 GB LPDDR4 memory down
- four shader GPU and Multiformat VPU with H.265 support
- LVDS support (via MIPI-DSI)
- DP (via MIPI-DSI)
- 1x Gigabit Ethernet with internal MAC and PHY and 1x GB via PCIe controller, WOL support
- Support for Audio and common features (SPI, I2C, SMB etc.)
- Optional eMMC flash onboard
- Full industrial grade temp. range E2 (-40°C up to +85°C) for standard SKUs, commercial version possible
- APPROTECT (security chip) support on request, more information under https://www.kontron.de/products/solutions/security

2.3. Product Variants and Accessories

Following variants are planned:

Table 1: Product Variants of SMARC-sAMX8X

Product Number	Product Name	Configuration
51010-3008-12-4+	SMARC-sAMX8X quad X+ 3G/8S all features	SMARC with NXP i.MX8X, quadX+ 1.2 GHz; 3 GB LPDDR4, 8 GB eMMC pSLC, LVDS, DP, 2x LAN, 3x PCIe
51010-1508-12-2+	SMARC-sAMX8X dual X+ 1.2GHz 1.5G/8S all features	SMARC with NXP i.MX8X, dualX+ 1.2 GHz; 1.5 GB LPDDR4, 8 GB eMMC pSLC, LVDS, DP, 2x LAN, 3x PCIe
51010-1004-12-2	SMARC-sAMX8X dual X 1G/4S LVDS only 1 x PCIe	SMARC with NXP i.MX8X, dualX 1.2 GHz; 1 GB LPDDR4, 4 GB eMMC pSLC, LVDS only, 1x PCIe

Following accessories are available:

- SMARC 2.0 Evaluation Carrier
- SMARC Starter Kit

2.4. SMARC-sAMX8X Feature Set

Table 2: SMARC-sAMX8X Feature Set

SMARC™ Feature specification	SMARC™ Specification Maximum Number Possible	SMARC-sAMX8X Feature support	Description
LVDS Display support	1	1x	2 x MIPI-DSI/LVDS Combo PHY*
CSI Camera support	2	1x	1 x MIPI CSI with option 2 lanes or 4 lanes
USB Interface	6 x USB 2.0 with 2 x USB 3.0 included	5x USB 2.0 via USB Hub 1x USB 3.0 1x USB2 OTG with PHY	1x USB OTG ports, 5x USB host ports + 1x with internal security key option/APPROTECT)
PCIe Interface	4	1x	4-Port/4-Lane Interface 128-LQFP
GbE Interface	2	2x GbE	1x GB Ethernet + 1GB Ethernet optional via PCIe controller
SDIO Interface	1	1x	
SPI Interface	2	2x	2x Quad/1x Octal SPI
I2S Interface	2	1x option	Default leads to SMARC connector.
I2C Interface	5	3x	External Fast I2C_GP from Embedded Controller or CPU I2C_PM for Power Management
CAN	2	2x	Option: SER2 RTC/CTS shared with CAN0
UART		4x	Option: SER2 RTC/CTS shared with CAN0
GPIOs		12x GPIOs	

3/ System Specifications

3.1. Component Main Data

The table below summarizes the features of the motherboard.

Table 3: Component Main Data

SMARC-sAMX8X	
Form factor	Short size Smart Mobility ARChitecture (SMARC) Hardware with 82 mm x 50 mm, max. thickness 6 mm
Processor	NXP i.MX8X 19mm x 19mm BGA package with 609 balls in 0.8 mm and 0.65mm pitch (industrial version). Used processor types are i.MX 8 QuadXPlus, i.MX 8 DualXPlus and i.MX 8 DualX.
Memory	Up to 4 GB LPDDR4 @ 1200 MHz (no ECC)
Boot Flash	8 MB to 256 MB SPI NOR flash
Bootloader/BIOS	U-Boot Bootloader, Flash for Bootloader connected on SPI0.
embedded Multimedia Card (eMMC)	▶ 2 to 32 GB pseudo Single Level Cell (pSLC) ▶ 4 to 128 GB MLC (Multi-level Cell)
EEPROM	▶ Type: 24C32, 4k x 8 (32 kbit) ▶ Connected at I2C_GP bus at address 0x50 (7-bit)
Display	▶ 18/24-bit LVDS RGB (True Color) ▶ Resolution: up to 1920x1080 Pixel from MIPI-DSI ▶ Single/Dual Channel
Onboard Controllers	
Ethernet Controller	1x GBE PHY DP83867IR, second ETH controller I210 optionally with PCIe switch
Watchdog Timer	CPU internal watchdog, configurable timeout counter with timeout periods from 0.5 to 128 seconds
USB HUB	USB HUB USB2517i for 5x USB 2.0 ports on SMARC Con.
PCI Switch	PCIe packet switch PI7C9X2G404SL
Display bridge	MIPI DSI to LVDS Flatlink SN65DSI84ZQER
Real Time Clock (RTC)	High accuracy (+/-3%), low power, RV-8803
System Management Controller	No dedicated System Management Controller on module System settings can be arranged in U-Boot environment variables
Storage	2 to 128 GB eMMC 5.0 Flash (option)
H/W Status Monitor	Voltage monitoring
Security	APPROTECT Key optional
Power management	▶ Clock Control Module (CCM) ▶ General Power Controller (GPC) ▶ System Reset Controller (SRC)
Operating System Support	Linux Yocto, other Operating Systems only on customer request
Interfaces via Smarc I/O	
I2C	External Fast I2C_GP from Embedded Controller or CPU I2C_PM for Power Management

LAN, USB	1x Gb-Ethernet + 1x Gb-Ethernet optional via PCIe controller, 1x USB 3.0 OTG on USB#3, 1x USB 3.0 on USB#2, 5x USB 2.0 xHCI, via USB Hub
PCIe	Konfiguration 1 (default) ▶ PCIe Switch and LAN Controller ▶ 2x PCIe at SMARC connector via PCIe SW (PCIeA + PCIeB) ▶ 1x PCIe to LAN Controller via PCIe SW ▶ Second Ethernet on ETH1 Konfiguration 2 (economic) ▶ Without PCIe Switch and LAN Controller ▶ 1x PCIe A on SMARC connector directly from i.MX8 CPU ▶ No ETH1 Konfiguration 3 (dual LAN, no PCIe) ▶ Without PCIe Switch and with LAN Controller ▶ No PCIe at SMARC connectors ▶ LAN Controller directly connected to PCIe from CPU Konfiguration 4 (PCIe, no 2nd LAN) ▶ PCIe Switch and without LAN Controller ▶ 3x PCIe at SMARC connector via PCIe SW (PCIe A, PCIeB, PCIeC) ▶ No ETH1
Audio	Carrier board Audio with external I2S Codec
Display	Dual channel LVDS 1/2x18/24bit (openLDI and VESA) up to 1920x1200 from MIPI-DSI
Camera	MIPI CSI camera support default: 2lane interface, option to switch to 4 lane interface
SD-Card	1x SDIO
Serial Peripheral Interface (SPI)	2 x SPI interface on defined pins for external Boot and general purpose devices
SER	4x serial ports with full function according to SMARC 2.0. SER2 handshake lines are either CAN0 or SER2 handshake, via BOM option and configuration.
GPIO	6x General Purpose Inputs/Outputs (GPIO)
Other Connectivity	Keypad, 2x CAN
Power	
Input Voltage	Wide range VCC 3.0 V to 5.25 V
Power Supply Limits	Voltage Ripple maximum 200mV peak to peak at 0 to 20 MHz 0.1 to 20ms rise time from input voltage ≤10% to nominal VCC inrush current peak limit. G3/S5 to S0 acc. SFX Design Guide
Power Features	▶ Module shall power on automatically in single supply operation when VCC is connected (Uboot setting) ▶ Module shall be possibly reconfigured to start after PowerButton, when VCC is connected
Security	
	▶ HAB, SRTC, SJTAG, TrustZone® ▶ AES256, RSA4096, SHA-256 ▶ 3DES, ARC4, MD-5 ▶ Flashless SHE, ECC ▶ Tamper, Inline Enc Engine

3.2. Environmental Conditions

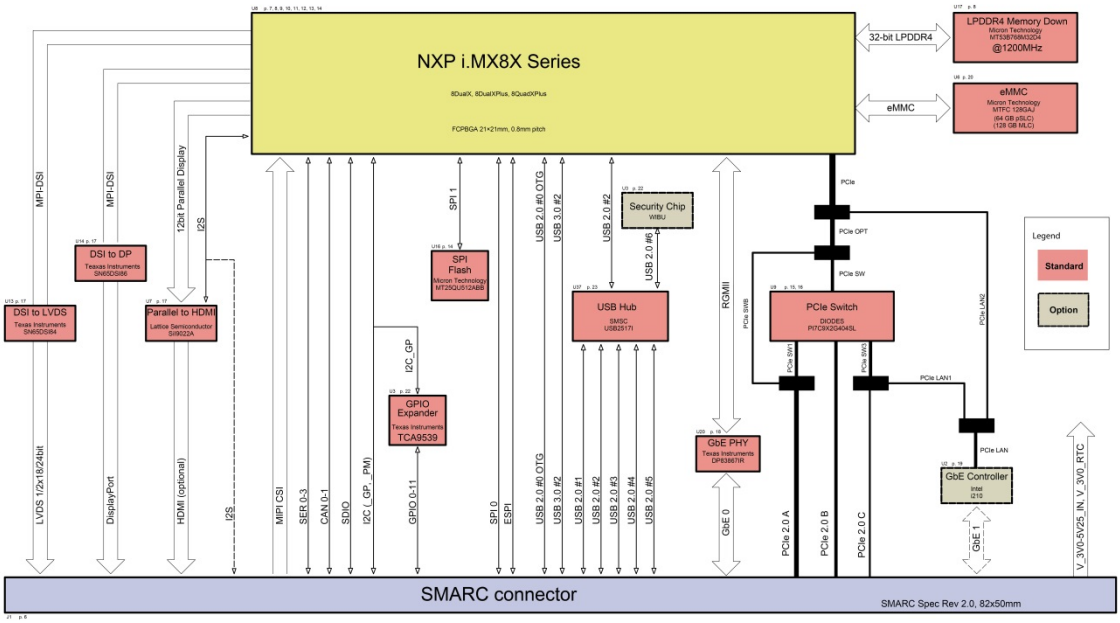
Table 4: Environmental Conditions

Operating	▶ 0°C to 60°C (on request for cost optimization) ▶ -40°C to 85°C (by design)
Storage	-40°C to +85°C
Relative Humidity	non-condensing 10 % to 93 % at 40°C acc. to IEC 60068-2-78
Electromagnetic Compatibility (EMC)	According to EN55032 (Class B), EN61000-6-2 and EN61000-6-4
CE	EN 62368-1:2014 - Safety for audio/video and information technology equipment
UL	Component Recognition to UL62368-1 - Information Technology Equipment Including Electrical Business Equipment
REACH	REACH compliant (Regulation (EC) No 1907/2006)
WEEE	WEEE compliant (Directive 2012/19/EU)
Shock and Vibration	Shock & Vibration according to ▶ IEC/EN60068-2-27 (Non-operating shock test – half-sinusoidal, 11 ms, 15 g) and ▶ IEC/EN60068-2-6 (Non-operating vibration – sinusoidal, 10 Hz – 4000 Hz, +/- 0.15 mm, 2 g)
Theoretical MTBF	estimated 10 years at 40°C
RoHS II Compliance	The product is RoHS II compliant (Directive 2011/65/EU)

3.3. Functional Block Diagram

The block diagram shows all available interfaces on the sAMX8X module.

Figure 2: Block Diagram



4/ Board and Connectors

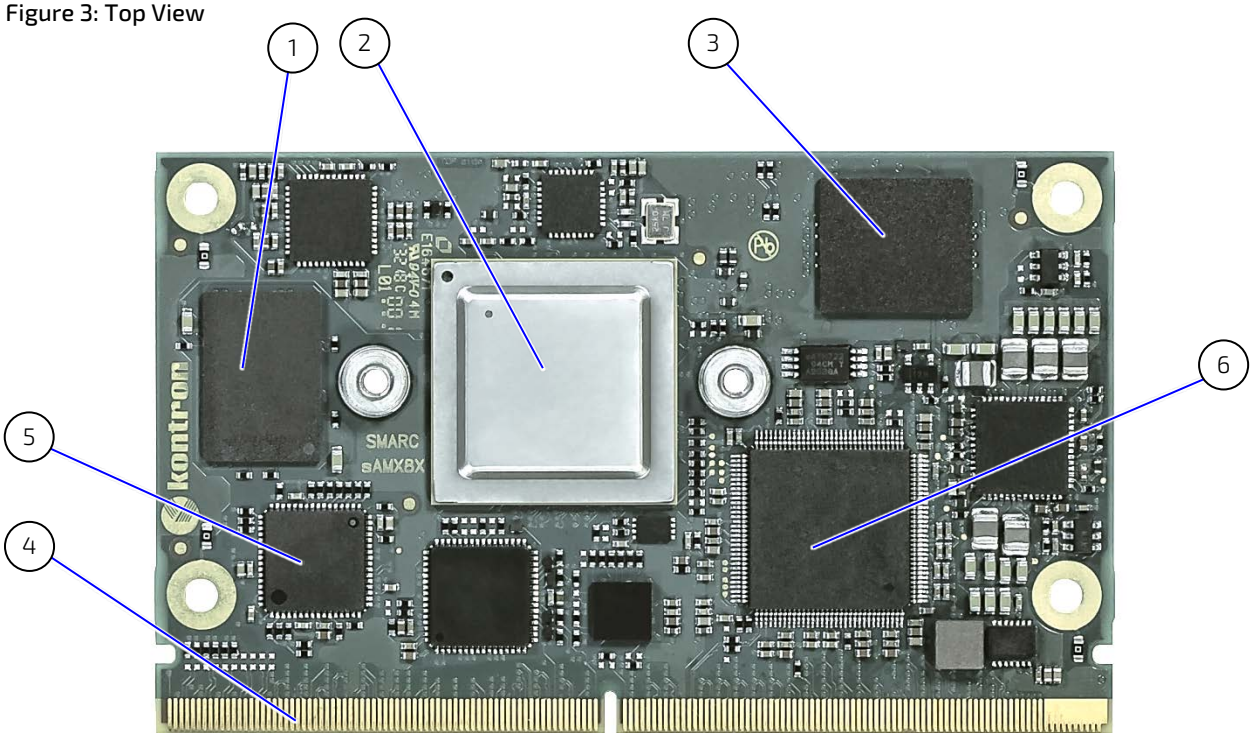
4.1. Connectors

Table 5: Connectors of SMARC-sAMX8X

Connector	Function	Remark
SMARC	Central Interface	Mating connector: SMARC 2.0 (MXM3)

4.2. Mainboard view and I/O locations

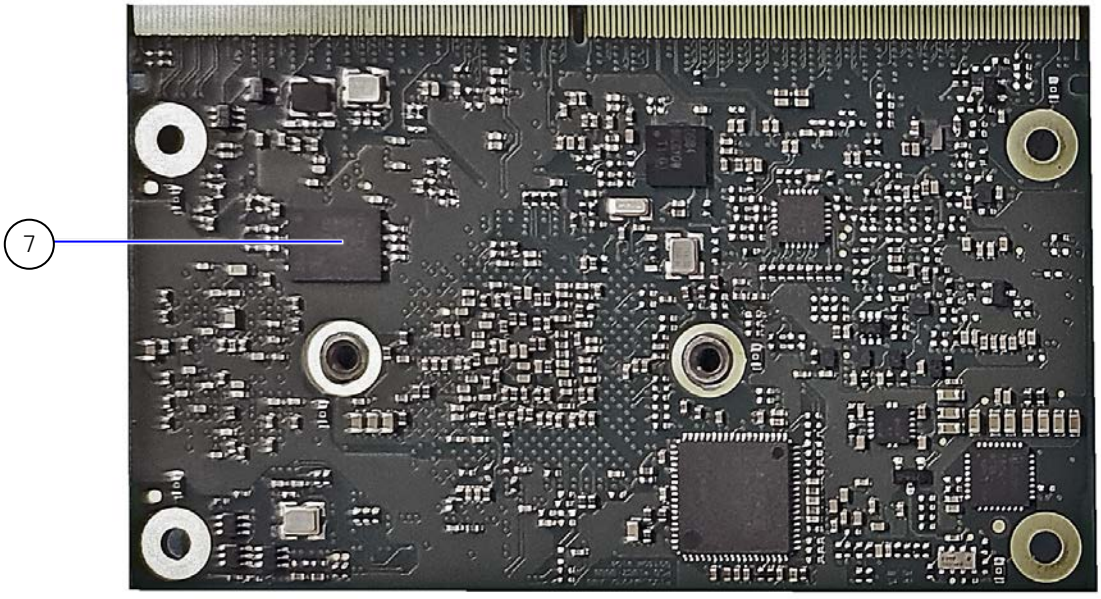
Figure 3: Top View



1. LPDD4 memory
2. Freescale Processor
3. embedded MultiMedia Card (eMMC)
4. SMARC Interface
5. GbE 1 on PCIe (optional)
6. PCIe switch

4.3. Bottom Side

Figure 4: Bottom Side from SMARC-sAMX8X



7. SPI Flash

4.4. Mechanical Drawings

Figure 5: Dimensions of SMARC-sAMX8X

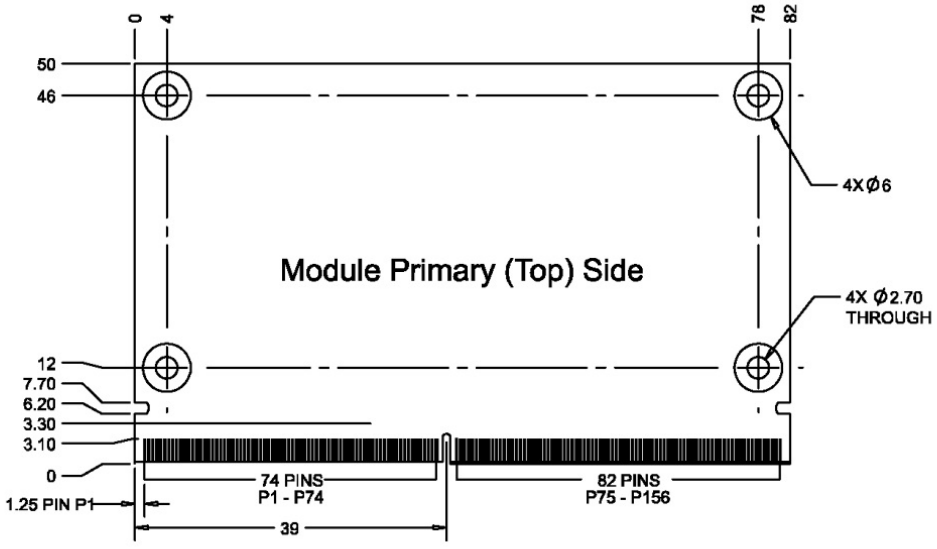
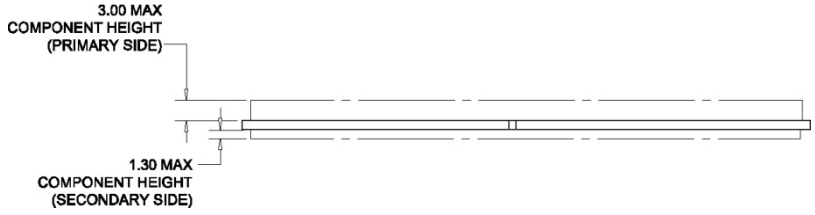


Figure 6: Thickness from side view



4.5. Thermal Considerations

The Cooling concept is based on a standard cooler for SMARC modules with mounting holes for iMX8X module.

Figure 7: Heatspreader Top View with screw holes

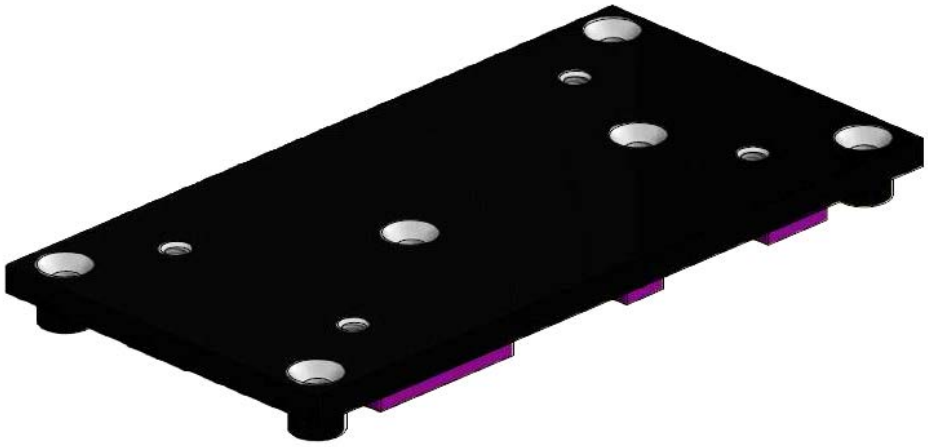
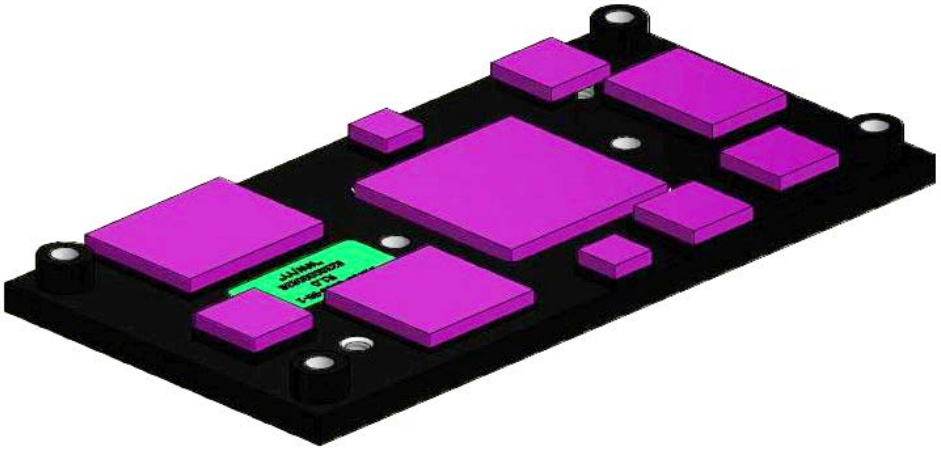


Figure 8: Heatspreader Bottom View



NOTICE Heat spreader mechanical data are available on customer section.

5/ Pin Definitions

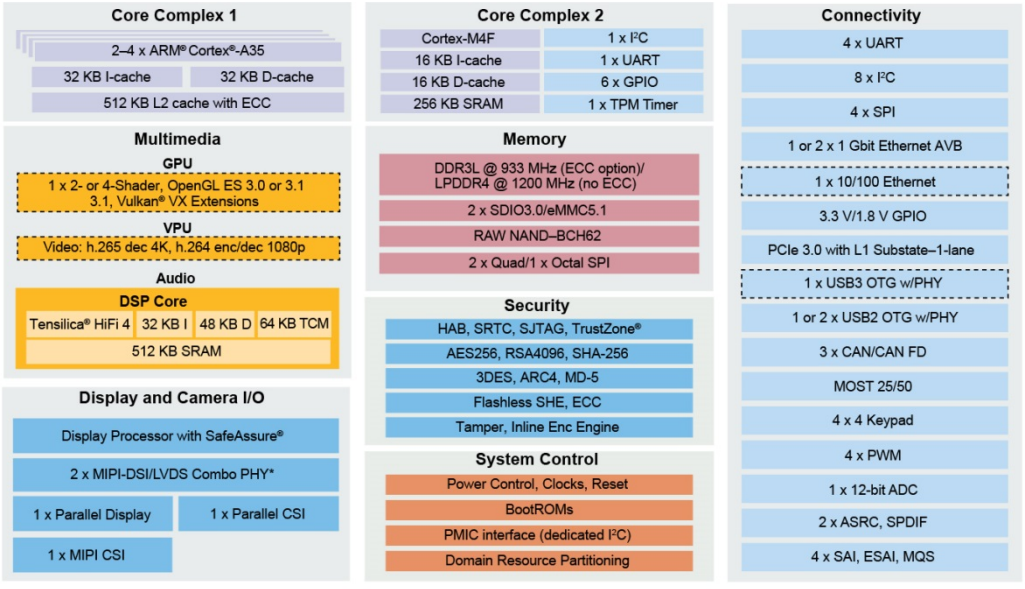
5.1. Processor Support

Kontron uses a NXP i.MX8X chip with with 19 mm x 19 mm BGA package in 0.75 mm pitch available.

Table 6: Processor Support

Name	Speed	RAM	Cache	Tj
8QuadXPlus	4x 1.2 GHz	32-bit DDR3L (ECC option) LPDDR4 (no ECC)	512 KB with ECC	-20°C to 105°C (Automotive: 125°C)
8DualXPlus	2x 1.2 GHz	32-bit DDR3L (ECC option) LPDDR4 (no ECC)	512 KB with ECC	-20°C to 105°C (Automotive: 125°C)
8DualX	2x 1.2 GHz	16-bit DDR3L (ECC option) LPDDR4 (no ECC)	512 KB with ECC	-20°C to 105°C (Automotive: 125°C)

Figure 9: Processor Block Diagram (Source: NXP)



5.2. System Memory Support

The system supports the following memory features:

- LPDDR4 @ 1200 MHz (no ECC)

Table 7: Memory Options

Processor type	RAM
8DualX	16-bit LPDDR4 (no ECC)
8Dual Plus, 8QuadXPlus	32-bit LPDDR4 (no ECC)

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. During the manufacturing process, Multi Level Cell (MLC) eMMC is reconfigured to act as a pseudo Single Level Cell (pSLC) eMMC to provide improved reliability, endurance and performance.

NOTICE **eMMC is default assembled 16 GB MLC on Quad and 8 GB MLC on Dual variant.**

Specific eMMC Flash memory features are:

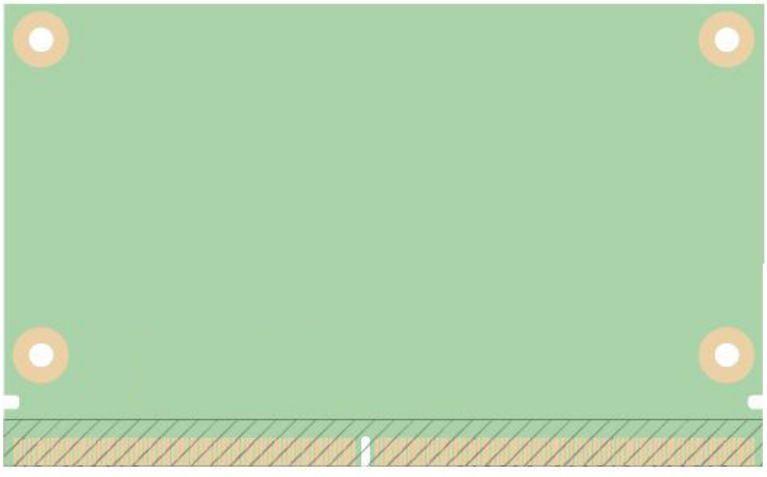
- Up to 64 GByte pSLC (or128 GB MLC)
- eMMC 5.1 specification
- Class 0 (basic); class 2 (block read); class 4 (block write); class 5 (erase); class 6 (write protection); class 7 (lock card)
- HS200/HS400 modes
- DDR modes up to 52 MHz clock speed
- ECC and block management
- Boot operation (High-speed 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 10: 314-pin SMARC Connector,



5.5. Pinout of SMARC sAMX8X Connector

5.5.1. Pinout of SMARC sAMX8X Topside Connector

NOTICE Pin Type/Tolerance definition is according to SMARC Specification

Table 8: Pinout of SMARC sAMX8X Topside Connector

Pin	Signal	Module Direction	Module Termination	Type/ Tolerance	Controller	Power Rail
P1	SMB_ALERT_1V8#	In	-	CMOS 1.8V	iMX8X	
P2	GND	-	-	-	-	GND
P3	CSI1_CK+	In	-	LVDS D-PHY	NC or iMX8X	-
P4	CSI1_CK-	In	-	LVDS D-PHY	NC or iMX8X	-
P5	GBE1_SDP	Bi-Dir	-	CMOS 3.3V	I210	-
P6	GBE0_SDP	Bi-Dir	-	CMOS 3.3V	DP83867IR	-
P7	CSI1_RX0+	In	-	LVDS D-PHY	iMX8X or NC	-
P8	CSI1_RX0-	In	-	LVDS D-PHY	iMX8X or NC	-
P9	GND	-	-	-	-	GND
P10	CSI1_RX1+	In	-	LVDS D-PHY	iMX8X or NC	-
P11	CSI1_RX1-	In	-	LVDS D-PHY	iMX8X or NC	-
P12	GND	-	-	-	-	GND
P13	CSI1_RX2+	In	-	LVDS D-PHY	iMX8X or NC	-
P14	CSI1_RX2-	In	-	LVDS D-PHY	iMX8X or NC	-
P15	GND	-	-	-	-	GND
P16	CSI1_RX3+	In	-	LVDS D-PHY	iMX8X or NC	-
P17	CSI1_RX3-	In	-	LVDS D-PHY	iMX8X or NC	-
P18	GND	-	-	-	-	GND
P19	GBE0_MDI3-	Bi-Dir	-	GBE MDI	DP83867IR	-
P20	GBE0_MDI3+	Bi-Dir	-	GBE MDI	DP83867IR	-
P21	GBE0_LINK100#	Out/OD	-	CMOS 3.3V	DP83867IR	-
P22	GBE0_LINK1000#	Out/OD	-	CMOS 3.3V	DP83867IR	-
P23	GBE0_MDI2-	Bi-Dir	-	GBE MDI	DP83867IR	-
P24	GBE0_MDI2+	Bi-Dir	-	GBE MDI	DP83867IR	-
P25	GBE0_LINK_ACT#	Out/OD	-	CMOS 3.3V	DP83867IR	-
P26	GBE0_MDI1-	Bi-Dir	-	GBE MDI	DP83867IR	-
P27	GBE0_MDI1+	Bi-Dir	-	GBE MDI	DP83867IR	-
P28	GBE0_CTREF	Out	NC	-	-	-
P29	GBE0_MDI0-	Bi-Dir	-	GBE MDI	DP83867IR	-
P30	GBE0_MDI0+	Bi-Dir	-	GBE MDI	DP83867IR	-
P31	SPI0_CS1#	Out	-	CMOS 1.8V	iMX8X	-
P32	GND	-	-	-	-	GND
P33	SDIO_WP	In	PU-100k	CMOS 3.3V	iMX8X	V_3V3
P34	SDIO_CMD	Bi-Dir	-	CMOS 3.3V	iMX8X	-
P35	SDIO_CD#	In	PU-100k	CMOS 3.3V	iMX8X	V_3V3
P36	SDIO_CK	Out	-	CMOS 3.3V	iMX8X	-
P37	SDIO_PWR_EN	Out	-	CMOS 3.3V	iMX8X	-
P38	GND	-	-	-	-	GND
P39	SDIO_D0	Bi-Dir	-	CMOS 3.3V	iMX8X	-

Pin	Signal	Module Direction	Module Termination	Type/ Tolerance	Controller	Power Rail
P40	SDIO_D1	Bi-Dir	-	CMOS 3.3V	iMX8X	_
P41	SDIO_D2	Bi-Dir	-	CMOS 3.3V	iMX8X	_
P42	SDIO_D3	Bi-Dir	-	CMOS 3.3V	iMX8X	_
P43	SPI0_CS0#	Out	-	CMOS 1.8V	iMX8X	_
P44	SPI0_CK	Out	-	CMOS 1.8V	iMX8X	_
P45	SPI0_DIN	In	-	CMOS 1.8V	iMX8X	_
P46	SPI0_DO	Out	-	CMOS 1.8V	iMX8X	_
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	iMX8X	_
P55	ESPI_CS1#	Out	-	CMOS 1.8V	iMX8X	_
P56	ESPI_CK	Out	-	CMOS 1.8V	iMX8X	_
P57	ESPI_IO_1	Bi-Dir	-	CMOS 1.8V	iMX8X	_
P58	ESPI_IO_0	Bi-Dir	-	CMOS 1.8V	iMX8X	_
P59	GND	-	-	-	-	GND
P60	USB0+	Bi-Dir	-	USB	iMX8X	_
P61	USB0-	Bi-Dir	-	USB	iMX8X	_
P62	USB0_EN_OC#	Bi-Dir OD	PU-10k	CMOS 3.3V	iMX8X	V_3V3
P63	USB0_VBUS_DET	In	PD-110k	USB VBUS 5V	iMX8X	-
P64	USB0_OTG_ID	In	-	CMOS 3.3V	iMX8X	_
P65	USB1+	Bi-Dir	-	USB	USB2517i	_
P66	USB1-	Bi-Dir	-	USB	USB2517i	_
P67	USB1_EN_OC#	Bi-Dir OD	PU-10k	CMOS 3.3V	USB2517i	V_3V3
P68	GND	-	-	-	-	GND
P69	USB2+	Bi-Dir	-	USB	USB2517i	_
P70	USB2-	Bi-Dir	-	USB	USB2517i	_
P71	USB2_EN_OC#	Bi-Dir OD	PU-10k	CMOS 3.3V	USB2517i	V_3V3
P72	RSVD	-	NC	-	-	_
P73	RSVD	-	NC	-	-	_
P74	USB3_EN_OC#	Bi-Dir OD	PU-10k	CMOS 3.3V	USB2517i	V_3V3
P75	PCIE_A_RST#	Out	-	CMOS 3.3V	iMX8X or PI7C9X2G404 SL	-
P76	USB4_EN_OC#	Bi-Dir OD	PU-10k	CMOS 3.3V	USB2517i	V_3V3
P77	RSVD	-	NC	-	-	_
P78	RSVD	-	NC	-	-	_
P79	GND	-	-	-	-	GND
P80	PCIE_C_REFCK+	Out	PD-49R9	LVDS PCIe	PI7C9X2G404 SL	-
P81	PCIE_C_REFCK-	Out	PD-49R9	LVDS PCIe	PI7C9X2G404 SL	-
P82	GND	-	-	-	-	GND
P83	PCIE_A_REFCK+	Out	-	LVDS PCIe	9FGL0441	_
P84	PCIE_A_REFCK-	Out	-	LVDS PCIe	9FGL0441	_

Pin	Signal	Module Direction	Module Termination	Type/ Tolerance	Controller	Power Rail
P85	GND	-	-	-	-	GND
P86	PCIE_A_RX+	In	Serial-0R	LVDS PCIe	Option: iMX8X or PI7C9X2G404 SL	-
P87	PCIE_A_RX-	In	Serial-0R	LVDS PCIe	Option: iMX8X or PI7C9X2G404 SL	-
P88	GND	-	-	-	-	GND
P89	PCIE_A_TX+	Out	Serial-100n	LVDS PCIe	Option: iMX8X or PI7C9X2G404 SL	-
P90	PCIE_A_TX-	Out	Serial-100n	LVDS PCIe	Option: iMX8X or PI7C9X2G404 SL	-
P91	GND	-	-	-	-	GND
P92	HDMI_D2+ /DP1_LANE0+	Out	-	TMDS	SiI9022A	-
P93	HDMI_D2- /DP1_LANE0-	Out	-	TMDS	SiI9022A	-
P94	GND	-	-	-	-	GND
P95	HDMI_D1+/DP1_LANE1+	Out	-	TMDS	SiI9022A	-
P96	HDMI_D1- /DP1_LANE1-	Out	-	TMDS	SiI9022A	-
P97	GND	-	-	-	-	GND
P98	HDMI_D0+ /DP1_LANE2+	Out	-	TMDS	SiI9022A	-
P99	HDMI_D0- /DP1_LANE2-	Out	-	TMDS	SiI9022A	-
P100	GND	-	-	-	-	GND
P101	HDMI_CK+ /DP1_LANE3+	Out	-	TMDS	SiI9022A	-
P102	HDMI_CK /DP1_LANE3-	Out	-	TMDS	SiI9022A	-
P103	GND	-	-	-	-	GND
P104	HDMI_HPD/DP1_HPD	In	PD-100k	CMOS 1.8V	SiI9022A	-
P105	HDMI_CTRL_CK/DP1_AUX+	Bi-Dir	PU-2k2	CMOS 1.8V	SiI9022A	V_1V8
P106	HDMI_CTRL_DAT/DP1_AUX-	Bi-Dir	PU-2k2	CMOS 1.8V	SiI9022A	V_1V8
P107	DP1_AUX_SEL	In	PD-1Meg	CMOS 1.8V	-	-
P108	GPIO0/CAM0_PWR#	Bi-Dir	PU-470k	CMOS 1.8V	TCA9539	V_1V8
P109	GPIO1/CAM1_PWR#	Bi-Dir	PU-470k	CMOS 1.8V	TCA9539	V_1V8
P110	GPIO2/CAM0_RST#	Bi-Dir	PU-470k	CMOS 1.8V	TCA9539	V_1V8
P111	GPIO3/CAM1_RST#	Bi-Dir	PU-470k	CMOS 1.8V	TCA9539	V_1V8
P112	GPIO4/HDA_RST#	Bi-Dir	PU-470k	CMOS 1.8V	TCA9539	V_1V8
P113	GPIO5/PWM_OUT	Bi-Dir	PU-470k	CMOS 1.8V	TCA9539	V_1V8
P114	GPIO6/TACHIN	Bi-Dir	PU-470k	CMOS 1.8V	TCA9539	V_1V8
P115	GPIO7	Bi-Dir	PU-470k	CMOS 1.8V	TCA9539	V_1V8
P116	GPIO8	Bi-Dir	PU-470k	CMOS 1.8V	TCA9539	V_1V8
P117	GPIO9	Bi-Dir	PU-470k	CMOS 1.8V	TCA9539	V_1V8
P118	GPIO10	Bi-Dir	PU-470k	CMOS 1.8V	TCA9539	V_1V8

Pin	Signal	Module Direction	Module Termination	Type/ Tolerance	Controller	Power Rail
P119	GPIO11	Bi-Dir	PU-470k	CMOS 1.8V	TCA9539	V_1V8
P120	GND	-	-	-	-	GND
P121	I2C_PM_CK	Bi-Dir	PU-4k7	CMOS 1.8V	iMX8X	V_1V8
P122	I2C_PM_DAT	Bi-Dir	PU-4k7	CMOS 1.8V	iMX8X	V_1V8
P123	BOOT_SEL0#	In	PU-10k	CMOS 1.8V	iMX8X	V_1V8
P124	BOOT_SEL1#	In	PU-10k	CMOS 1.8V	iMX8X	V_1V8
P125	BOOT_SEL2#	In	PU-10k	CMOS 1.8V	iMX8X	V_1V8
P126	RESET_OUT#	Out -OD	-	CMOS 1.8V	SN74AUP1G12 5DRY	-
P127	RESET_IN#	In	PU-10k + Buffer	CMOS 1.8V	Buffer	V_1V8_SCU
P128	POWER_BTN#	In	PU-100k	CMOS 1.8V	i.MX8X	V_1V8_SNVS
P129	SER0_TX	Out	-	CMOS 1.8V	iMX8X	_
P130	SER0_RX	In	-	CMOS 1.8V	iMX8X	_
P131	SER0_RTS#	Out	-	CMOS 1.8V	iMX8X	_
P132	SER0_CTS#	In	-	CMOS 1.8V	iMX8X	_
P133	GND	-	-	-	-	GND
P134	SER1_TX	Out	-	CMOS 1.8V	iMX8X	_
P135	SER1_RX	In	-	CMOS 1.8V	iMX8X	_
P136	SER2_TX	Out	-	CMOS 1.8V	iMX8X	_
P137	SER2_RX	In	-	CMOS 1.8V	iMX8X	_
P138	SER2_RTS#	Out	PU-10k	CMOS 1.8V	iMX8X or NC	V_1V8
P139	SER2_CTS#	In	-	CMOS 1.8V	iMX8X or NC	_
P140	SER3_TX	Out	-	CMOS 1.8V	iMX8X	_
P141	SER3_RX	In	-	CMOS 1.8V	iMX8X	_
P142	GND	-	-	-	-	GND
P143	CAN0_TX	Out	-	CMOS 1.8V	iMX8X or NC	_
P144	CAN0_RX	In	-	CMOS 1.8V	iMX8X or NC	_
P145	CAN1_TX	Out	-	CMOS 1.8V	iMX8X	_
P146	CAN1_RX	In	-	CMOS 1.8V	iMX8X	_
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 sAMX8X Bottom Side Connector

Table 9: Pinout of SMARC sAMX8X Bottom Side Connector

Pin	Signal	Module Direction	Module Termination	Type/ Tolerance	Controller	Power Rail
S1	CSI1_TX+/I2C_CAM1_CK	Bi-Dir	PU-4K7 or NC	TMDS/CMOS 1.8V	iMX8X or NC	V_1V8
S2	CSI1_TX-/I2C_CAM1_DAT	Bi-Dir	PU-4K7 or NC	TMDS/CMOS 1.8V	iMX8X or NC	V_1V8
S3	GND	-	-	-	-	GND
S4	RSVD	-	NC	-	-	-
S5	CSI0_TX+/I2C_CAM0_CK	Bi-Dir	PU-4K7 or NC	TMDS/CMOS 1.8V	iMX8X or NC	V_1V8
S6	CAM_MCK	Out	-	CMOS 1.8V	iMX8X	-
S7	CSI0_TX-/I2C_CAM0_DAT	Bi-Dir	PU-4K7 or NC	TMDS/CMOS 1.8V	iMX8X or NC	V_1V8
S8	CSI0_CK+	In	-	LVDS D-PHY	iMX8X or NC	-
S9	CSI0_CK-	In	-	LVDS D-PHY	iMX8X or NC	-
S10	GND	-	-	-	-	GND
S11	CSI0_RX0+	In	-	LVDS D-PHY	iMX8X or NC	-
S12	CSI0_RX0-	In	-	LVDS D-PHY	iMX8X or NC	-
S13	GND	-	-	-	-	GND
S14	CSI0_RX1+	In	-	LVDS D-PHY	iMX8X or NC	-
S15	CSI0_RX1-	In	-	LVDS D-PHY	iMX8X or NC	-
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	-	USB	USB2517I	-
S36	USB4-	Bi-Dir	-	USB	USB2517I	
S37	USB3_VBUS_DET	In	NC	USB VBUS 5V	-	-
S38	AUDIO_MCK	Out	Serial 33R	CMOS 1.8V	iMX8X	
S39	I2S0_LRCK	Bi-Dir	NC or -	CMOS 1.8V	NC or iMX8X	-
S40	I2S0_SDOUT	Out	NC or -	CMOS 1.8V	NC or iMX8X	-
S41	I2S0_SDIN	In	PD-10k	CMOS 1.8V	iMX8X	-

Pin	Signal	Module Direction	Module Termination	Type/ Tolerance	Controller	Power Rail
S42	I2S0_CK	Bi-Dir	-	CMOS 1.8V	iMX8X	-
S43	ESPI_ALERT0#	In	PU-10k	CMOS 1.8V	iMX8X	V_1V8
S44	ESPI_ALERT1#	In	PU-10k	CMOS 1.8V	iMX8X	V_1V8
S45	RSVD	-	-	-	-	-
S46	RSVD	-	-	-	-	-
S47	GND	-	-	-	-	GND
S48	I2C_GP_CK	Out	PU-4k7	CMOS 1.8V	iMX8X	V_1V8
S49	I2C_GP_DAT	Bi-Dir	PU-4k7	CMOS 1.8V	iMX8X	V_1V8
S50	HDA_SYNC/I2S2_LRCK	Bi-Dir	NC	CMOS 1.5V/1.8V	-	-
S51	HDA_SDO/I2S2_SDOUT	Out	NC	CMOS 1.5V/1.8V	-	-
S52	HDA_SDI/I2S2_SDIN	In	NC	CMOS 1.5V/1.8V	-	-
S53	HDA_CK/I2S2_CK	Bi-Dir	NC	CMOS 1.5V/1.8V	-	-
S54	SATA_ACT#	Out/OD	NC	CMOS 3.3V	-	-
S55	USB5_EN_OC#	Bi-Dir OD	PU-10k	CMOS 3.3V	USB2517I	V_3V3
S56	ESPI_IO_2	Bi-Dir	-	CMOS 1.8V	iMX8X	-
S57	ESPI_IO_3	Bi-Dir	-	CMOS 1.8V	iMX8X	-
S58	ESPI_RESET#	Out	-	CMOS 1.8V	SN74AUP1G08DRYR	-
S59	USB5+	Bi-Dir	-	USB	USB2517I	-
S60	USB5-	Bi-Dir	-	USB	USB2517I	-
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	USB2517I	-
S69	USB3-	Bi-Dir	-	USB	USB2517I	-
S70	GND	-	-	-	-	GND
S71	USB2_SSTX+	Out	Serial-100n	USB SS	iMX8X	-
S72	USB2_SSTX-	Out	Serial-100n	USB SS	iMX8X	-
S73	GND	-	-	-	-	GND
S74	USB2_SSRX+	In	-	USB SS	iMX8X	-
S75	USB2_SSRX-	In	-	USB SS	iMX8X	-
S76	PCIE_B_RST#	Out	-	CMOS 3.3V	PI7C9X2G404SL	-
S77	PCIE_C_RST#	Out	-	CMOS 3.3V	PI7C9X2G404SL	-
S78	PCIE_C_RX+	In	-	LVDS PCIe	PI7C9X2G404SL or NC	-
S79	PCIE_C_RX-	In	-	LVDS PCIe	PI7C9X2G404SL or NC	-
S80	GND	-	-	-	-	GND
S81	PCIE_C_TX+	Out	Serial-100n or NC	LVDS PCIe	PI7C9X2G404SL or NC	-
S82	PCIE_C_TX-	Out	Serial-100n or NC	LVDS PCIe	PI7C9X2G404SL or NC	-

Pin	Signal	Module Direction	Module Termination	Type/ Tolerance	Controller	Power Rail
S83	GND	-	-	-	-	GND
S84	PCIE_B_REFCK+	Out	PD-49R9 or NC	LVDS PCIe	PI7C9X2G404 SL or NC	-
S85	PCIE_B_REFCK-	Out	PD-49R9 or NC	LVDS PCIe	PI7C9X2G404 SL or NC	-
S86	GND	-	-	-	-	GND
S87	PCIE_B_RX+	In	-	LVDS PCIe	PI7C9X2G404 SL or NC	-
S88	PCIE_B_RX-	In	-	LVDS PCIe	PI7C9X2G404 SL or NC	-
S89	GND	-	-	-	-	GND
S90	PCIE_B_TX+	Out	Serial-100n or NC	LVDS PCIe	PI7C9X2G404 SL or NC	-
S91	PCIE_B_TX-	Out	Serial-100n or NC	LVDS PCIe	PI7C9X2G404 SL or NC	-
S92	GND	-	-	-	-	GND
S93	DP0_LANE0+	Out	-	LVDS PCIE	SN65DSI86 or NC	-
S94	DP0_LANE0-	Out	-	LVDS PCIE	SN65DSI86 or NC	-
S95	DP0_AUX_SEL	In	PD-1Meg	CMOS 1.8V	-	-
S96	DP0_LANE1+	Out	-	LVDS PCIE	SN65DSI86 or NC	-
S97	DP0_LANE1-	Out	-	LVDS PCIE	SN65DSI86 or NC	-
S98	DP0_HPD	In	-	CMOS 1.8V	SN65DSI86	-
S99	DP0_LANE2+	Out	-	LVDS PCIE	SN65DSI86 or NC	-
S100	DP0_LANE2-	Out	-	LVDS PCIE	SN65DSI86 or NC	-
S101	GND	-	-	-	-	GND
S102	DP0_LANE3+	Out	-	LVDS PCIE	SN65DSI86 or NC	-
S103	DP0_LANE3-	Out	-	LVDS PCIE	SN65DSI86 or NC	-
S104	USB3_OTG_ID	In	NC	CMOS 3.3V	NC	-
S105	DP0_AUX+	Bi-Dir	Serial-100n PD-100k	LVDS PCIE	SN65DSI86 or NC	-
S106	DP0_AUX-	Bi-Dir	Serial-100n PU-100k	LVDS PCIE	SN65DSI86 or NC	-
S107	LCD1_BKLT_EN	Out	-	CMOS 1.8V	iMX8X	-
S108	LVDS1_CK+/eDP1_AUX+/DSI1_CLK+	Out	-	LVDS LCD	SN65DSI84	-
S109	LVDS1_CK-/eDP1_AUX-/DSI1_CLK-	Out	-	LVDS LCD	SN65DSI84	-
S110	GND	-	-	-	-	GND
S111	LVDS1_0+/EDP1_TX0+/DSI1_D0+	Out	-	LVDS LCD	SN65DSI84	-
S112	LVDS1_0-/EDP1_TX0-/DSI1_D0-	Out	-	LVDS LCD	SN65DSI84	-
S113	eDP1_HPD	In	NC	CMOS 1.8V	NC	-
S114	LVDS1_1+/EDP1_TX1+/DSI1_D1+	Out	-	LVDS LCD	SN65DSI84	
S115	LVDS1_1-/EDP1_TX1-/DSI1_D1-	Out	-	LVDS LCD	SN65DSI84	-

Pin	Signal	Module Direction	Module Termination	Type/ Tolerance	Controller	Power Rail
S116	LCD1_VDD_EN	Out	-	CMOS 1.8V	iMX8X	-
S117	LVDS1_2+/eDP1_TX2+/DSI1_D2+	Out	-	LVDS LCD	SN65DSI84	-
S118	LVDS1_2-/eDP1_TX2-/DSI1_D2-	Out	-	LVDS LCD	SN65DSI84	-
S119	GND	-	-	-	-	GND
S120	LVDS1_3+/eDP1_TX3+/DSI1_D3+	Out	-	LVDS LCD	SN65DSI84	-
S121	LVDS1_3-/eDP1_TX3-/DSI1_D3-	Out	-	LVDS LCD	SN65DSI84	-
S122	LCD1_BKLT_PWM	Out	-	CMOS 1.8V	iMX8X	-
S123	RSVD	-	-	-	-	-
S124	GND	-	-	-	-	GND
S125	LVDS0_0+/eDP0_TX0+/DSI0_D0+	Out	-	LVDS LCD	SN65DSI84	-
S126	LVDS0_0-/eDP0_TX0-/DSI0_D0-	Out	-	LVDS LCD	SN65DSI84	-
S127	LCD0_BKLT_EN	Out	-	CMOS 1.8V	iMX8X	-
S128	LVDS0_1+/eDP0_TX1+/DSI0_D1+	Out	-	LVDS LCD	SN65DSI84	-
S129	LVDS0_1-/eDP0_TX1-/DSI0_D1-	Out	-	LVDS LCD	SN65DSI84	-
S130	GND	-	-	-	-	GND
S131	LVDS0_2+/eDP0_TX2+/DSI0_D2+	Out	-	LVDS LCD	SN65DSI84	-
S132	LVDS0_2-/eDP0_TX2-/DSI0_D2-	Out	-	LVDS LCD	SN65DSI84	-
S133	LCD0_VDD_EN	Out	-	CMOS 1.8V	iMX8X	-
S134	LVDS0_CK+/eDP0_AUX+/DSI0_CLK+	Out	-	LVDS LCD	SN65DSI84	-
S135	LVDS0_CK-/eDP0_AUX-/DSI0_CLK-	Out	-	LVDS LCD	SN65DSI84	-
S136	GND	-	-	-	-	GND
S137	LVDS0_3+/eDP0_TX3+/DSI0_D3+	Out	-	LVDS LCD	SN65DSI84	-
S138	LVDS0_3-/eDP0_TX3-/DSI0_D3-	Out	-	LVDS LCD	SN65DSI84	-
S139	I2C_LCD_CK	Out	PU-4k7	CMOS 1.8V	iMX8X and SN65DSI84	V_1V8
S140	I2C_LCD_DAT	Bi-Dir	PU-4k7	CMOS 1.8V	iMX8X and SN65DSI84	V_1V8
S141	LCD0_BKLT_PWM	Out	-	CMOS 1.8V	iMX8X	-
S142	RSVD	-	NC	-	-	-
S143	GND	-	-	-	-	GND
S144	EDP0_HPD	In	NC	CMOS 1.8V	-	-
S145	WDT_TIME_OUT#	Out	-	CMOS 1.8V	Buffer	-
S146	PCIE_WAKE#	In	PU-39k2	CMOS 3.3V	iMX8X and i210	V_3V3

Pin	Signal	Module Direction	Module Termination	Type/ Tolerance	Controller	Power Rail
S147	VDD_RTC	-	Diode and Measurement circuit	PWR	RV-8803 and iMX8X	V_3V3_RTC (2.0V-3.25V)
S148	LID#	In	PU-10k	CMOS 1.8V	TCA9539	V_1V8
S149	SLEEP#	In	PU-10k	CMOS 1.8V	iMX8X	V_1V8_SCU
S150	VIN_PWR_BAD#	In	PU-10k	CMOS VDD_IN	POWER	Input power V_3V0-5V25_IN
S151	CHARGING#	In	PU-10k	CMOS 1.8V	iMX8X	V_1V8
S152	CHARGER_PRSNT#	In	PU-10k	CMOS 1.8V	iMX8X	V_1V8
S153	CARRIER_STBY#	Out	PU-10k	CMOS 1.8V	iMX8X	V_1V8
S154	CARRIER_PWR_ON	Out	PD-100k	CMOS 1.8V	SN74AUP1G125	-
S155	FORCE_RECOV#	In	PU-4k75	CMOS 1.8V	iMX8X	V_1V8_SCU
S156	BATLOW#	In	PU_10k	CMOS 1.8V	iMX8X	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_SEL0#, 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

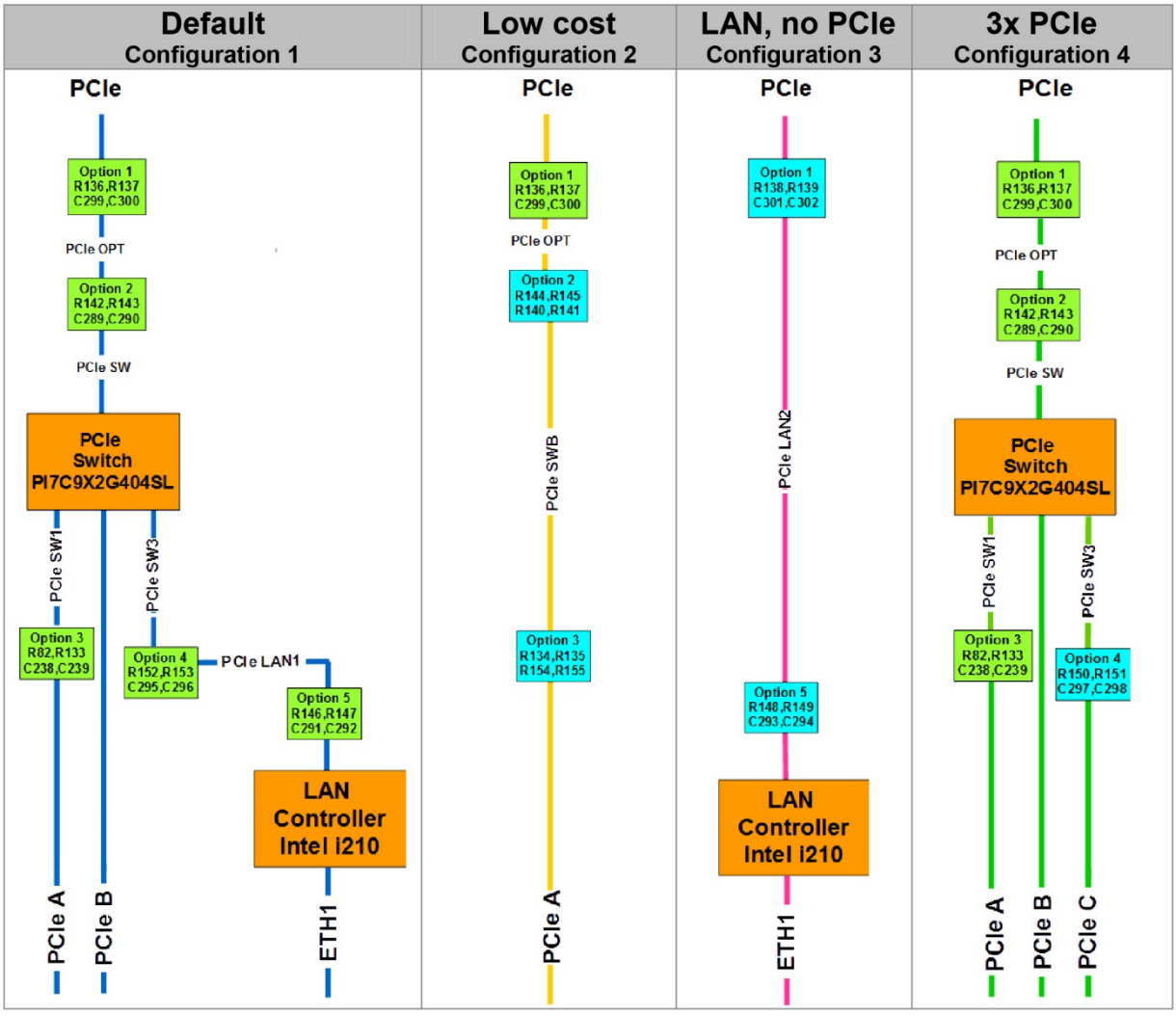
Configuration 3

- 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 11: 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:

- Configurable timeout counter with timeout periods from 0.5 to 128 seconds which, after timeout expiration, result in the assertion of WDOG_RESET_B_DEB reset signal .
- Time resolution of 0.5 seconds
- Configurable timeout counter that can be programmed to run or stop during low-power modes
- Programmable interrupt generation prior to timeout
- The duration between interrupt and timeout events can be programmed from 0 to 127.5 seconds in steps of 0.5 seconds.

6.4. RTC Current Consumption

The module RTC (RV-8803) can operate down to 1.5 V, the i.MX8X RTC minimum supply voltage is 2.4 V. Due to the higher current consumption of the i-MX8X RTC this part is not powered with the V_RTC voltage rail.

RV-8803 is powered through Schottky diode BAS70 from V_VDD_RTC pin S147 of SMARC con.

6.5. 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
SER0	UART1
SER1	UART3
SER2	UART0
SER3	UART2

Configuring the UART for DTE mode will result in the signals being routed to the SMARC pins in conformance with the SMARC definition of the pin functions.

6.6. Power Control

6.6.1. Power Supply

The SMARC-sAMX8X supports a power input from 3.0 to 5.25 V. 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)

NOTICE

To protect external power lines of peripheral devices, make sure that the wires have the right diameter to withstand the maximum available current. The enclosure of the peripheral device fulfills the fire-protection requirements of IEC/EN62368.

6.6.2. 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 ms ≤ t < 4 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).

6.6.3. Power Bad Signal (VIN_POWER_BAD#)

The SMARC-sAMX8X 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.

6.6.4. 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.

NOTICE

To protect external power lines of peripheral devices, make sure that the wires have the right diameter to withstand the maximum available current. The enclosure of the peripheral device has to fulfill the fire-protection requirements of IEC/EN62368.

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

SMARC-sAMX8X 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.

NOTICE

The source code of U-Boot will be delivered with the standard software package. Additionally the software can be downloaded from Kontron GitHub repository for SMARC-sAMX8X: https://github.com/kontron/u-boot-smarc-sAMX8X

7.2. Bootloader Quickstart

The SMARC-sAMX8X 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 SER2 port of the module. On Kontron SMARC 2.0 carrier this port is named SER_2.
- 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 3 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

.

```
U-Boot <Version> (<Date-code>)

CPU:   Freescale i.MX8XD rev1.2 at 996MHz
CPU:   Extended Commercial temperature grade (-20C to 105C) at 54C
Reset cause: POR
Board: Kontron SMX8X SMARC 2.0 Module
I2C:   ready
DRAM:  2 GiB
MMC:   FSL_SDHC: 0, FSL_SDHC: 1
SF: Detected w25q16dw with page size 256 Bytes, erase size 4 KiB, total 2 MiB
In:    serial
Out:   serial
Err:   serial
Net:   FEC0, FEC1

Hit any key to stop autoboot:  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_sAMX8X 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. Kontron Bootloader Command Extensions

Kontron's implementation of U-Boot includes certain enhancements to provide board specific functions. They are not part of standard U-Boot as maintained by DENX. The following table provides a complete listing of all Kontron command extensions on the SMARC-sAMX8X.

Table 11: Bootloader Command Extensions

Command	Description
kboardinfo	Kontron Board Information - Displays a summary of board and configuration information
md5sum	Creates or checks the md5 message digest over a memory area
watchdog	Start and control i.MX8X CPU watchdog

7.4.1. kboardinfo - Kontron Board Information

The "kboardinfo" command shows a summary of board serialization data gathered from the system EEPROM.

```
=> kboardinfo
Manufacturer:        Kontron Europe GmbH
Product name:        SMARC-sAMX8X
Material number:     51009-0208-10-2
Serial number:       NZD070001
MAC0 (ethaddr):      00:a0:a5:79:25:30
MAC1 (eth1addr):     00:a0:a5:79:25:31
Manufacturer Date:   11/15/2017
Revision:            B00
Boot Counter:        10
CPU:                 Freescale i.MX8XD rev1.2 at 996 MHz
==>
```

7.4.2. md5sum – MD5 Message Digest

The "md5sum" command is already part of standard U-Boot implementation. However Kontron provides the "-a" extension (ASCII) that allows to check MD5 checksum of a given memory area (e.g. a binary image copied into memory) against the checksum that has been copied into an ASCII file on an external linux host. To achieve this, the ASCII string in the file representing the checksum is converted into hexadecimal values and compared against the calculated one.

Syntax:

```
=> help md5sum
md5sum - compute MD5 message digest

Usage:
md5sum address count [[*]sum]
    - compute MD5 message digest [save to sum]
md5sum -v address count [*]sum
    - verify md5sum of memory area
md5sum -a address count [*]sum
    - verify md5sum given in ASCII format
```

Example:

Calculate MD5 checksum of a given binary using the md5sum command on linux host and redirect output messages into a file:

```
# md5sum image.bin >image.md5
```

Copy both image file and checksum file to USB thumb device with EXT2/3/4 or FAT partition. Connect the USB device to the module carrier.

The following sequence shows how to load both image file and image checksum file into SMARC_sAMX8X memory and compare them. In case of success, the "md5sum -a" command will have no output messages as this extensions is meant to be used in automatic update scripts to check the binary images against their MD5 checksum.

```
usb start
load usb 0:1 88000000 <image.bin>
load usb 0:1 8a000000 <image.md5>
if md5sum -a 88000000 $ubootsz *88a00000; then
    echo  'CRC check passed'
else
    echo  'CRC check failed'
fi
```

7.4.3. Watchdog – CPU Watchdog Control

The "watchdog" command is used to control the i.MX8X CPU internal watchdog. After watchdog has been started using "watchdog start", the watchdog is kicked periodically by U-Boot to prevent expiration.

Watchdog timeout can be changed at any time. However, it is not possible to stop watchdog once it has been started.

Syntax:

```
=> help watchdog
watchdog - start/stop/kick IMX watchdog

Usage:
watchdog <timeout>       - kick watchdog and set timeout (0 = disable kicking)
watchdog start <timeout> - start watchdog and set timeout
```

Example:

Start watchdog with 5 seconds timeout and stop kicking watchdog some time later. Board will reset after watchdog has been expired.

```
=> watchdog 5
=> watchdog 0
```

7.5. 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_sAMX8X module as shown below.

Table 12: 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.

7.6. Bootloader Environment Update

On the SMARC-sAMX8X it is possible to update the U-Boot environment separately.

This enables the user to either update from a previous version of the official Kontron sAMX8X U-Boot environment (default U-Boot settings), or restore the default in case of problems.

Update procedure:

- Download the official sAMX8X U-Boot environment from the Kontron EMD Customer Section.
- For Release R10 of the sAMX8X U-Boot, the file is called 'sMX8X-env-r10.bin'.
- Put the file into the root directory of a FAT or EXT formatted USB drive.
- Start the sAMX8X system and stop the boot process at the U-Boot prompt.
- Run the following commands to load the file and flash it into the correct flash memory address (example for R10):

```
usb start && load usb 0:1 $loadaddr sMX8X-env-r10.bin
sf probe && sf update $loadaddr 0x0c0000 $filesize
```

- After reset the updated environment will be active.

7.7. Kontron Bootloader Environment Extensions

To support SMARC_sAMX8X board properly, Kontron adds some environment variables to the standard set of variables provided by mainline U-Boot. These variables are shown below.

Table 13: Bootloader Environment Extensions

Variable	Value	Description
boot_sel	Depends on BOOT_SEL lines	BOOT_SEL lines from carrier are evaluated during startup and boot_sel is set appropriately. See chapter 0 Bootloader Boot Source for more detail
core_variant	d s	Set to "s" for i.MX8XS module, "d" for i.MX8XD module.
eth1addr	From EEPROM	Ethernet port FEC1 MAC address
ethaddr	From EEPROM	Ethernet port FEC0 MAC address
fdt_addr	0x83000000	Memory location for device tree blob

Variable	Value	Description
panel	Default: ld101	Describes the panel type attached to the module. It is used to select the appropriate device tree file
pcie_a_prsnt	yes	Enable/disable PCIE_A PRSNT line to reduce power consumption
pcie_b_prsnt	yes	Enable/disable PCIE_B PRSNT line to reduce power consumption
pcie_c_prsnt	yes	Enable/disable PCIE_C PRSNT line to reduce power consumption
pwm_out_disable	yes	Enable/disable PWM_OUT signal. When disabled, GPIO5 pin on SMARC edge connector is used as GPIO.
serial#	From EEPROM	Module serial number

Variables from the table above marked in bold are set automatically each time U-Boot starts. They will override different settings possibly stored in persistent environment.

7.8. Bootloader Mass Storage Support

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

- QSPI flash
- eMMC device
- SD card
- USB thumb device

7.8.1. QSPI flash

QSPI flash is accessed using the "sf" command

Example: Load one sector (64K) from SPI flash

```
=> sf probe 0
=> sf read ${loadaddr} 0 10000
```

7.8.2. SD Card and eMMC Devices

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

Example: Load 256 blocks from eMMC

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

7.8.3. USB Storage Device

USB 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
```

7.9. Bootloader File System Support

U-Boot for the SMARC_sAMX8X provides support for FAT and EXT4 file systems. EXT4 support also includes EXT2 and EXT3 formatted file systems. There are file system specific commands available to list file system contents (ext2ls, fatls) and load a given file into board memory (ext2load, fatload). However, U-Boot also provides generic commands ("ls" and "load"), that will detect the file system on the device and use appropriate file system functions automatically.

Example: Show/boot folder contents from SD card file system

```
=> ls mmc 0:1 /boot
<DIR>       4096 .
<DIR>       4096 ..
<SYM>         48 iMX8Xd-sAMX8X-ld101-m4.dtb
          44034 devicetree-zImage-iMX8Xd-sAMX8X-ld101-m4.dtb
          43986 devicetree-zImage-iMX8Xd-sAMX8X-ld101.dtb
<SYM>         33 zImage
<SYM>         45 iMX8Xd-sAMX8X-ld101.dtb
<SYM>         45 iMX8Xs-sAMX8X-ld101.dtb
        6376512 zImage-4.1.29-fslc+g59b38c3
          43998 devicetree-zImage-iMX8Xs-sAMX8X-ld101.dtb

=> load mmc 0:1 ${loadaddr} /boot/zImage
6376512 bytes read in 536 ms (11.3 MiB/s)
```

7.9.1. EXT4 File System Write Support

There is even support available to write a given memory area into ext4 formatted file systems. However, the implementation is not bullet proof und should be used with care, as this could lead to file system corruption.

Writing to symbolic links in an ext4 filesystem does not work from u-boot!
Do not create new files in ext4 filesystem as this could cause problems.

7.10. Bootloader Network Support

U-Boot provides support for both onboard Ethernet interfaces. The current interface can be selected by setting "ethact" environment variable to either “FEC0” or “FEC1”.

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" ord "dhcp" commands.

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

Example:

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

7.11. Bootloader Boot Source Support

The SMARC v2.0 Specification defines three boot select signals BOOT_SEL[0:2]# that allows the user to select from eight possible boot devices. On the SMARC_sAMX8X, U-Boot detects the BOOT_SEL signals from the carrier and sets the environment variable "boot_sel" as shown below.

Table 14: Environment Variables for "boot_sel"

BOOT_SEL2#	BOOT_SEL1#	BOOT_SEL0#	boot_sel	Boot Source
GND	GND	GND	carrier_sata	Carrier SATA
GND	GND	Float	carrier_sd	Carrier SD Card
GND	Float	GND	carrier_mmc	Carrier eSPI (CS0#)
GND	Float	Float	carrier_spi	Carrier SPI (CS0#)
Float	GND	GND	module_device	Module Device (NAND, NOR) – vendor specific
Float	GND	Float	remote	Remote boot (GBE, serial) – vendor specific
Float	Float	GND	module_mmc	Module eMMC Flash
Float	Float	Float	module_spi	Module SPI

Bootloader environment scripts can use the boot_sel environment variable to select the source where the dedicated OS image can be loaded. As an example, the bootloader environment of the SMARC_sAMX8X implements some small scripts that will load a linux system from the boot source as defined by the BOOT_SEL pins.

```
bootsel_boot=echo BOOT_SEL ${boot_sel} selected && run ${boot_sel}_boot
module_mmc_boot=run mmcboot
module_spi_boot=run mmcboot
```

Running the "run bootsel_boot" script will load a linux system from MMC if BOOT_SEL pins define the module MMC Flash or the Module SPI as boot source. Depending on application, the script variables in environment can be adapted.

The bootloader is always booted from the boot source defined by fuse settings, which is normally the QSPI flash device. The BOOT_SEL pins only define boot source for the OS.

7.12. Bootloader Boot Counter

The module EEPROM device contents implements a SMBIOS Running-time data block (type 161) as defined in the KEU EEPROM Specification Rev. 1.4. The running-time data block structure implements a 64bit boot counter. U-Boot on the SMARC_sAMX8X module will read the current boot counter value and increment it on every boot cycle. Current boot counter is shown as part of the information shown by the "kboardinfo" command (see description of kboardinfo).

7.13. Bootloader Update

Bootloader update on SMARC_sAMX8X is using an update script containing all necessary checks and installation commands. It is provided by Kontron on an USB thumb device containing the scriptfile and update images in the dedicated "update_sMX8X_spl" folder.

As an alternative it is possible to perform bootloader update from network. To achieve this, the "update_sMX8X_spl" folder mentioned above must have been copied to the server path of the TFTP server machine.

Given these prerequisites are met, update can be done from bootloader CLI using the predefined "update" script:

```
=> run update
```

Or, in case of network update

```
=> run updNet
```

It is recommended to use only the update script for bootloader update. This ensures that all necessary installation images are checksum controlled and copied to the appropriate location in QSPI flash.

8/ Technical Support

For technical support contact our Support department:

E-mail: 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)

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.

8.1. 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.

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

8.2. 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

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.

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). 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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