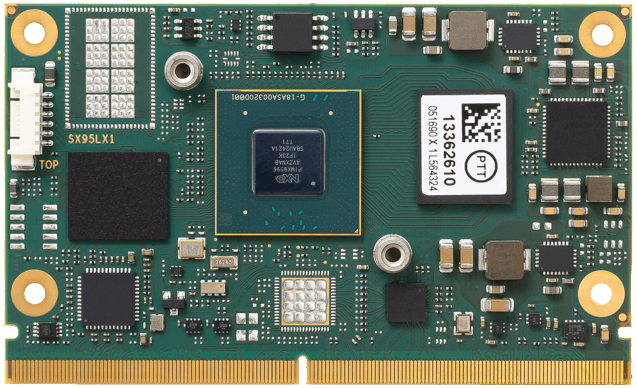

conga-SMX95

SMARC 2.2 Module with NXP® i.MX 95 processor

User's Guide

Revision 0.1

Revision History

Revision	Date (yyyy-mm-dd)	Author	Changes
0.1	2025-12-01	RVI	• Preliminary release

Preface

This user's guide provides information about the components, features and connectors available on the conga-SMX95 revision A.0 and later. It is one of five documents that should be referred to when designing a SMARC application.

The other reference documents that should be used include the following:

conga-SMX95 Pinout Description (https://git.congatec.com/arm-nxp/imx9-family-ea/doc/cgtimx95_pinlist/-/blob/cgtsx95_pinlist)
SMARC Design Guide 2.2 (https://sget.org)
SMARC Hardware Specification 2.2 (https://sget.org)
NXP® i.MX 95 Application Processor Data Sheet (www.nxp.com)

Ensure regular consultation of the customer login area at www.congatec.com and the congatec customer knowledge base at wiki.congatec.com for the most recent and legally binding product-related documents—such as errata sheets, list of limitation, and Product Change Notifications (PCNs).

Additionally, refer to the official websites of the respective silicon vendors for further information, including general chip limitations, errata sheets, sighting reports, and other technical or regulatory updates. These documents may contain mandatory and legally relevant information concerning product usage, compliance, and performance.

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Intended Audience

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RoHS Directive

All congatec GmbH designs comply with EU RoHS Directive 2011/65/EU and Delegated Directive 2015/863.

WEEE Directive

To comply with Directive 2012/19/EU on Waste Electrical and Electronic Equipment (WEEE), ensure that this product is disposed of correctly at the end of its lifecycle. Customers are required to take electrical and electronic equipment to designated collection facilities separate from unsorted municipal waste, following applicable regional laws.

Proper disposal through designated collection points allows for the recycling, recovery, and reuse of valuable materials, supporting a more efficient use of resources and reducing environmental impact.

Note

Standalone congatec components, such as modules, carrier boards, and cooling solutions are designed to function only within other products. WEEE registration for the complete product must be completed by the entity placing the final product on the market.

Electrostatic Sensitive Device

All congatec GmbH products are electrostatic sensitive devices. They are enclosed in static shielding bags, and shipped enclosed in secondary packaging (protective packaging). The secondary packaging does not provide electrostatic protection.

Do not remove the device from the static shielding bag or handle it, except at an electrostatic-free workstation. Also, do not ship or store electronic devices near strong electrostatic, electromagnetic, magnetic, or radioactive fields unless the device is contained within its original packaging. Be aware that failure to comply with these guidelines will void the congatec GmbH Limited Warranty.

Symbols

The following symbols are used in this user's guide:

Warning

Warnings indicate conditions that, if not observed, can cause personal injury.

Caution

Cautions warn the user about how to prevent damage to hardware or loss of data.

Note

Notes call attention to important information that should be observed.

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Technical Support

congatec GmbH technicians and engineers are committed to providing the best possible technical support for our customers so that our products can be easily used and implemented. We request that you first visit our website at www.congatec.com for the latest documentation, utilities and drivers, which have been made available to assist you. If you still require assistance after visiting our website then contact our technical support department by email at support@congatec.com.

Wireless Regulatory Compliance

Declaration for Wireless Compliance

We hereby expressly point out that this product is not a radio/wireless equipment (end product) according to regulations such as the Radio Equipment Directive and the Federal Communications Commission (RED, FCC). This product is only a sub-assembly, which has to be integrated into the end product by the customer and is not functional without further integration. The customer is solely and exclusively responsible for complying with all applicable and local regulations relating to the end product (e.g., RED, FCC) and for having the necessary (testing) procedures and certifications carried out at their own expense.

Scope of System-Level Compliance Testing

Due to the modular nature of COMs and their broad applicability, congatec performs preliminary system-level compliance testing using representative commercial off-the-shelf (COTS) accessories, including antennas. The purpose of these tests is to demonstrate the feasibility of achieving compliance in final customer-designed products and to show that the functionality and conformity of the used Wi-Fi® module is not limited by the congatec design. However, test results are limited exclusively to the specific configurations tested by congatec. The results cannot be transferred directly to alternative configurations or designs but can be shared with customers for further information.

Cybersecurity Compliance under RED

congatec has thoroughly evaluated cybersecurity requirements outlined in standards such as EN 18031-1. By design, COMs (Computer-on-Modules) do not include the hardware and software required to support standalone cybersecurity assessments. Therefore, congatec modules alone do not meet these cybersecurity requirements. Compliance with cybersecurity requirements is thus the responsibility of the final product manufacturer, who has detailed knowledge of the intended use and operating environment. congatec actively supports its customers by providing necessary technical documentation to aid in achieving cybersecurity compliance.

Cybersecurity Maintenance under IEC® 62443-4-1

congatec provides security maintenance updates according to IEC® 62443-4-1. This includes monitoring component supplier information about hardware and firmware security vulnerabilities of the Wi-Fi® module.

congatec promptly informs customers about hardware and firmware security vulnerabilities via vulnerability disclosures and about product changes via Product Change Notifications (PCNs)—including changes implemented to mitigate security vulnerabilities. Customers are responsible for monitoring the PCNs, independently monitoring security vulnerabilities beyond hardware and firmware, assessing their implications, and implementing relevant security updates.

Certification Documentation for Wi-Fi® Module

For certification and compliance documentation, refer to the documentation from EZURIO™ or contact your local sales representative.

Terminology

Term	Description
°C	Degrees Celsius
µA	Microamp
µs	Microsecond
A	Ampere
AN	Application Note
ARM®	Advanced RISC Machine
AVB	Audio Video Bridging
BT	Bluetooth®
BOM	Bill of Material
CAAM	Cryptographic Acceleration and Assurance Module
CAN	Controller Area Network
CMOS	Complementary Metal Oxide Semiconductor
COM	Computer-on-Module
CPU	Central Processing Unit
CSI	Camera Serial Interface
CSP	Cooling Solution Passive
DDR	Double Data Rate
DIN®	Deutsches Institut für Normung
DP	DisplayPort
DP++	DisplayPort Dual-Mode
DRAM®	Dynamic Random Access Memory
DSI	Digital Serial Interface
D-SUB	D-Subminiature
eMMC™	embedded Multi-Media Controller
GB	Gigabyte
GbE	Gigabit Ethernet
GHz	Gigahertz
GND	Ground
GPIO	General-Purpose Input/Output
GPL	General Public License
GPU	Graphics Processing Unit
GTps	Gigatransfers per second
HW	Hardware
HAB	High Assurance Boot
HDMI®	High-Definition Multimedia Interface
HSP	Heat Spreader
Hz	Hertz
I/O	Input/Output
I²C (I2C)	Inter-Integrated Circuit
I²S (I2S)	Inter-Integrated Circuit Sound
IEC®	International Electrotechnical Commission
IEEE®	Institute of Electrical and Electronics Engineers
JTAG	Joint Test Action Group
KS	Key State
LGPL	Lesser General Public License
LPDDR	Low-Power Double Data Rate
LVDS	Low-Voltage Differential Signaling
Mbps	Megabits per second
MBps	Megabytes per second
MHz	Megahertz
mm	Millimeter
MMU	Memory Management Unit
mVpp	Millivolts Peak to Peak
MXM™	Mobile PCI Express Module
NC	Not Connected
Nm	Newton metre
NXP®	NeXt exPerience
OS	Operating System
OTG	On-The-Go
PCB	Printed Circuit Board
PCI Express™	Peripheral Component Interconnect Express
PCN	Product Change Notification
PHY	Physical Layer
PMIC	Power Management Integrated Circuit
PN	Part Number
QSPI	Quad Serial Peripheral Interface
RGMII	Reduced Gigabit-Media Independent Interface
RS-232	Recommended Standard 232
RTC	Real-Time Clock
SAI	Synchronous Audio Interface
SD	Secure Digital
SDIO	Secure Digital Input Output
SDR	Single Data Rate
SDRAM®	Synchronous Dynamic Random Access Memory
SDXC™	Secure Digital eXtended Capacity
SGET	Standardization Group for Embedded Technologies e.V
SMARC	Smart Mobility ARChitecture
SoC	System on Chip
SPI	Serial Peripheral Interface
TBD	To Be Defined
TSN	Time-Sensitive Networking
UART	Universal Asynchronous Receiver-Transmitter
U-Boot	Universal Boot Loader
UHS	Ultra High Speed
USB®	Universal Serial Bus
V	Volt
Vdc	Volts direct current
W	Watt
WEEE	Waste Electrical and Electronic Equipment
Wi-Fi®	Wireless Fidelity

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List of Tables

1 Introduction

1.1 SMARC Concept

The Standardization Group for Embedded Technologies e.V (SGET™) defined the SMARC standard for small form factor computer modules that target applications with low power, low cost and high performance. The SMARC connector and interfaces are optimized for high-speed communication, and are suitable for ARM® SoCs and low power x86 SoCs.

The SMARC standard bridges the gap between the COM Express® standard and the Qseven® standard by offering most of the interfaces defined in the COM Express® specification at a lower power. With a footprint of 82 mm x 50 mm or 82 mm x 80 mm, the SMARC standard promotes the design of highly integrated, energy efficient systems.

Due to its small size and lower power demands, PC appliance designers can design low cost devices as well as explore a huge variety of product development options—from compact space-saving designs to fully functional systems. This solution allows scalability, product diversification and faster time to market.

1.2 conga-SMX95

The conga-SMX95 is based on the SMARC 2.2 Specification and features an NXP® i.MX 95 ARM® Cortex™-A55 industrial application processor.

By offering most of the functional requirement for any SMARC application, the conga-SMX95 provides manufacturers and developers with a platform to jump-start the development of systems and applications based on SMARC specification. Together with the unique features of the i.MX 95 processor such as the integrated Neural Processing Unit (NPU) for AI and Machine Learning, its features and capabilities make conga-SMX95 an ideal platform for designing compact, energy-efficient, performance-oriented embedded systems.

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1.2.1 Options Information

The conga-SMX95 is available in two commercial variants:

Table 1 Commercial Variants

PN	051600	051601
NXP® Processor	i.MX 9596 6-core processor	i.MX 9596 6-core processor
Cortex™-A55	6x 1.8 GHz	6x 1.8 GHz
SDRAM®	8 GB LPDDR5 @ 2400 MHz	4 GB LPDDR5 @ 2400 MHz
Ethernet®	2x Gigabit Ethernet® with support for TSN	2x Gigabit Ethernet® with support for TSN
Wi-Fi® /BT	Assembly Option	Assembly Option
HDMI® [1]	Yes	Yes
DP	Assembly Option	Assembly Option
USB®	1x USB® 2.0 OTG 2x USB® 3.0 2x USB® 2.0	1x USB® 2.0 OTG 2x USB® 3.0 2x USB® 2.0
Audio	1x SMARC I2S 1x via HDMI® bridge	1x SMARC I2S 1x via HDMI® bridge

The conga-SMX95 is available in four industrial variants:

Table 2 Industrial Variants

PN	051610	051611	051612	051620
NXP® Processor	i.MX 9596 6-core processor	i.MX 9596 6-core processor	i.MX 9596 6-core processor	i.MX 9596 6-core processor
Cortex™-A55	6x 1.8 GHz	6x 1.8 GHz	6x 1.8 GHz	6x 1.8 GHz
SDRAM®	8 GB LPDDR5 @ 2400 MHz	4 GB LPDDR5 @ 2400 MHz	8 GB LPDDR5 @ 2400 MHz	8 GB LPDDR5 @ 2400 MHz
Ethernet®	2x Gigabit Ethernet® with support for TSN	2x Gigabit Ethernet® with support for TSN	2x Gigabit Ethernet® with support for TSN	2x Gigabit Ethernet® with support for TSN
Wi-Fi®/BT	Assembly Option	Assembly Option	Assembly Option	Onboard Wi-Fi® 6 + BT module Sona™ NX611
HDMI® [1,2]	Yes	Yes	No	Yes
DP	Assembly Option	Assembly Option	Yes	Assembly Option
USB®	1x USB® 2.0 OTG 2x USB® 3.0 2x USB® 2.0	1x USB® 2.0 OTG 2x USB® 3.0 2x USB® 2.0	1x USB® 2.0 OTG 2x USB® 3.0 2x USB® 2.0	1x USB® 2.0 OTG 2x USB® 3.0 2x USB® 2.0
Audio	1x SMARC I2S 1x via HDMI® bridge	1x SMARC I2S 1x via HDMI® bridge	2x SMARC I2S	1x SMARC I2S 1x via HDMI® bridge

Note

1. *HDMI® support is not available in PN: 051612 and all customized variants that support DP because HDMI® and DP are generated from the same DSI-port from the SoC and therefore, only one bridge-device can be populated on the module.*

2. *For all variants featuring HDMI® support, the I2S0 interface is not available on the SMARC connector.*

1.2.2 Accessories

Table 3 conga-SMX95 Adapters

PN	48000023	007010	020750
Product	RS232 adapter cable	conga-SEVAL	conga-SMC1/SMARC-ARM®
Description	RS232 adapter cable for conga-ARM® modules, used for console connection	Evaluation carrier board for SMARC modules	3.5" carrier board for congatec SMARC modules based on NXP® i.MX ARM® architecture

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2 Specifications

2.1 Feature List

Table 4 Feature Summary

Form Factor	SMARC form factor specification 2.2 (82 x 50 mm)	
SoC	NXP® i.MX 95	
SDRAM®	Up to 16 GB onboard LPDDR5 memory @ 6400 MT/s	
Storage	eMMC™ 5.1 up to 256 GByte	
Audio	Up to 2x I^2S HiFi 4 DSP	
Ethernet®	Up to 2x GbE with support for TSN | IEEE® 1588	
Video Interfaces	1x dual channel 24-bit LVDS 1x HDMI 2.0a through MIPI-DSI to HDMI bridge optional instead of HDMI: Display Port 1.4 1080p60 through MIPI-DSI to DisplayPort Bridge optional MIPI-DSI capable of supporting 4kp30 or 3840p60 instead of LVDS1 up to 2x MIPI-CSI 4-lanes (one shared with MIPI-CSI) optionally 1x MIPI-CSI 2-lane 2x integrated Image Signal Processor (ISP) for cameras with up to 12 MP resolution (on selected processor SKUs)	
I/O Interfaces	1x dual-role USB® 2.0 2x USB® 2.0 2x USB® 3.0 1x SDIO 3.0 2x PCIe 3.0 1-lane up to 5x I^2C	1x SPI 1x QSPI up to 3x UART (2x with Handshake) up to 2x CAN FD 14x GPIO optional soldered M.2 1216 WiFi 6/BT 5.4
Features	Watchdog timer Cortex™-A55 and Cortex™-M33 console	Onboard high-precision Real-Time Clock (RTC) optional JTAG™ debug interface
Bootloader	U-Boot	
Operating Systems	Linux® (Yocto Project™) Android™	
AI & Machine Learning	NXP eIQ® Neutron Neural Processing Unit (NPU) with up to 2 TOPS	NXP eIQ® ML Software Development Environment
Security	NXP EdgeLock® 2GO key management services Resource Domain Controller ARM® TrustZone® High Assurance Boot support side channel attack resistance	Cryptographic Acceleration and Assurance Module (CAAM) SHE, Encryption Engine AES-128, AES-256, 3DES, RC4, RSA4096, TRNG, SHA-1, SHA-2, SHA-256, MD-5 RSA-1024, 2048, 3072, 4096 and secure key storage

2.2 Supported Operating Systems

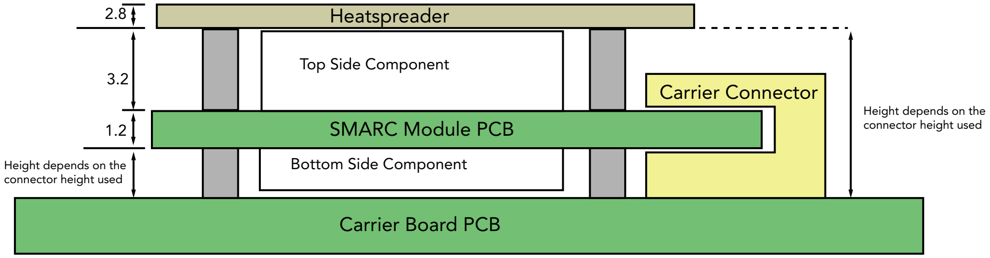
The conga-SMX95 supports the following operating systems:

- Linux® (Yocto Project™)
- Android™

2.3 Mechanical Dimensions

- 82.0 mm x 50.0 mm

The height of the module, heatspreader and stack is shown below:



All dimensions are in millimeters

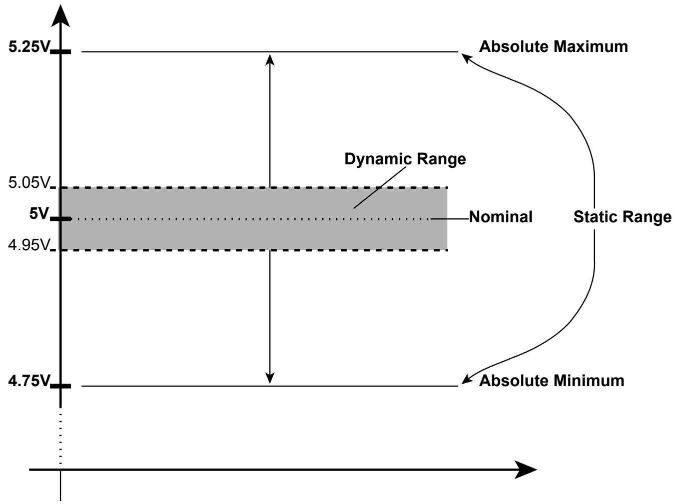
Note

3D models of congatec products are available at www.congatec.com/login. These models indicate the overall length, height and width of each product. If you need login access, contact your local sales representative.

2.4 Standard Power

2.4.1 Supply Voltage

- 4.75 V – 5.25 V



2.4.2 Electrical Characteristics

Characteristics			Min.	Typ.	Max.	Units	Comment
5V	Voltage	± 5%	4.75	5.00	5.25	Vdc	
	Ripple		-	-	± 50	mV_{PP}	0-20 MHz
	Current						

2.4.3 Rise Time

The input voltages shall rise from 10 percent of nominal to 90 percent of nominal at a rate of 250 V/s or faster. The smooth turn-on requires that, during the 10 percent to 90 percent portion of the rise time, the slope of the turn-on waveform must be positive.

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2.5 Power Consumption

The power consumption values for conga-SMX95 have not been determined at the time of this document's release and will be provided in a future revision.

The power consumption values are measured with the following setup:

- Input voltage +5 V
- conga-SMX95
- conga-SEVA carrier board
- conga-SMX95 cooling solution

The power consumption values are recorded during the following operating modes:

Table 5 Measurement Description

Mode	Description	Comment
KS1	Standby mode	For more information about the key power states, refer to NXP® documentation available on the website www.nxp.com.
KS3	User idle mode	
100%	100% CPU and GPU workload	The CPU and GPU was stressed to its maximum frequency.

The table below provides the power consumption values of each conga-SMX95 variant during different operating modes:

Table 6 Power Consumption Values

PN	Memory Size	HW Revision	U-Boot	SoC	Current (A) @ 5 V		
					KS1	KS3	100%
051600	8 GB	A.1	2024.04, cer_cgtsx95_25-01-23-0	i.MX 9596	TBD	TBD	TBD
051601	4 GB	A.1	2024.04, cer_cgtsx95_25-01-23-0	i.MX 9596	TBD	TBD	TBD
051610	8 GB	A.1	2024.04, cer_cgtsx95_25-01-23-0	i.MX 9596	TBD	TBD	TBD
051611	4 GB	A.1	2024.04, cer_cgtsx95_25-01-23-0	i.MX 9596	TBD	TBD	TBD
051612	8 GB	A.1	2024.04, cer_cgtsx95_25-01-23-0	i.MX 9596	TBD	TBD	TBD
051620	8 GB	A.1	2024.04, cer_cgtsx95_25-01-23-0	i.MX 9596	TBD	TBD	TBD

2.6 Supply Voltage Battery Power

The supply voltage battery power consumption values for conga-SMX95 have not been determined at the time of this document's release and will be provided in a future revision.

Table 7 CMOS Battery Power Consumption

RTC @	Voltage	Current
-10°C	3V DC	TBD µA
20°C	3V DC	TBD µA
70°C	3V DC	TBD µA

Note

1. *Do not use the CMOS battery power consumption values listed above to calculate CMOS battery lifetime.*
2. *Measure the CMOS battery power consumption in your customer specific application in worst case conditions (for example, during high temperature and high battery voltage).*
3. *Consider the self-discharge of the battery when calculating the lifetime of the CMOS battery. For more information, refer to application note AN9_RTC_Battery_Lifetime.pdf on congatec website at www.congatec.com/support/application-notes.*
4. *We recommend to always have a CMOS battery present when operating the conga-SMX95.*

2.7 Environmental Specifications

Temperature (commercial variants)	Operation: 0° to 60°C	Storage: -20° to +80°C
Temperature (industrial variants)	Operation: -40° to 85°C	Storage: -40° to +85°C
Relative Humidity	Operation: 10% to 85%	Storage: 5% to 85%

Caution

1. *The above operating temperatures must be strictly adhered to at all times. When using a congatec heat spreader, the maximum operating temperature refers to any measurable spot on the heat spreader's surface.*
2. *Humidity specifications are for non-condensing conditions.*

2.8 Storage Specifications

This section describes the storage conditions that must be observed for optimal performance of congatec products.

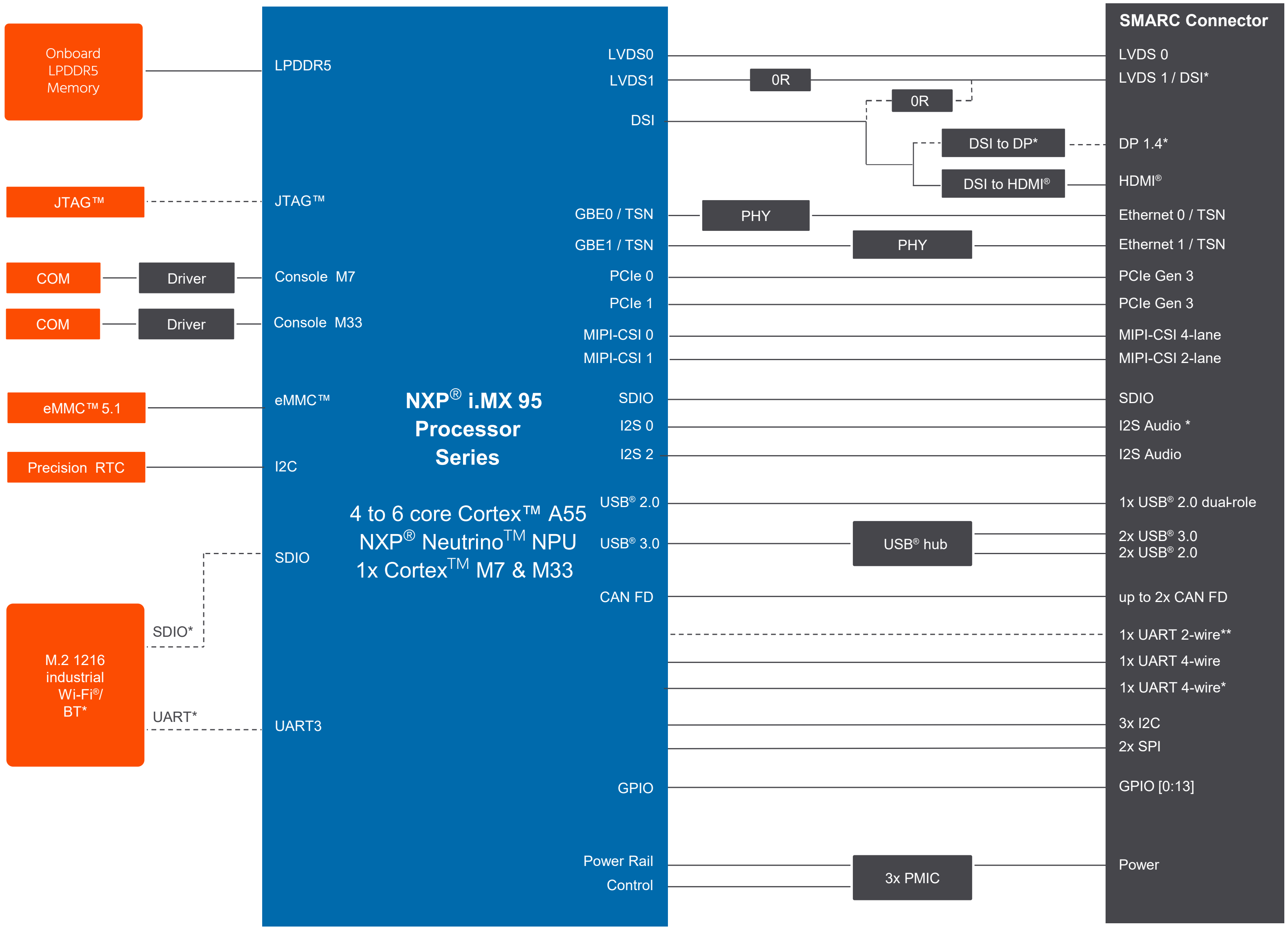
2.8.1 Module

For long-term storage of the conga-SMX95 (more than six months), keep the conga-SMX95 in a climate-controlled building at a constant temperature between 5°C and 40°C, with humidity of less than 65% and at an altitude of less than 3000 m. Also ensure the storage location is dry and well ventilated.

Note

We do not recommend storing the conga-SMX95 for more than five years under these conditions.

3 Block Diagram



* Assembly Option
** Shared with Console

4 Cooling Solutions

congatec GmbH offers the following cooling solutions for the conga-SMX95 variants. The dimensions of the cooling solutions are shown in the sub-sections. All measurements are in millimeters.

Table 8 Cooling Solution Variants

	Cooling Solution	Part No	Description
1	CSP	051652	Passive cooling solution for conga-SMX95 with NXP® i.MX 95 ARM® processor. All standoffs are with 2.7mm bore hole.
2	HSP	050153	Heatspreader for conga-SMX95 with NXP® i.MX 95 ARM® processor. All standoffs are with 2.7mm bore hole.

Caution

1. *The congatec heatspreaders/cooling solutions are tested only within the commercial temperature range of -40° to 60°C. Therefore, if your application that features a congatec heatspreader/cooling solution operates outside this temperature range, ensure the correct operating temperature of the module is maintained at all times. This may require additional cooling components for your final application's thermal solution.*

2. *For adequate heat dissipation, use the mounting holes on the cooling solution to attach it to the module. Apply thread-locking fluid on the screws if the cooling solution is used in a high shock and/or vibration environment. To prevent the standoff from stripping or cross-threading, use non-threaded carrier board standoffs to mount threaded cooling solutions.*

3. *For applications that require vertically-mounted cooling solution, use only coolers that secure the thermal stacks with fixing post. Without the fixing post feature, the thermal stacks may move.*

4. *Do not exceed the recommended maximum torque. Doing so may damage the module or the carrier board, or both.*

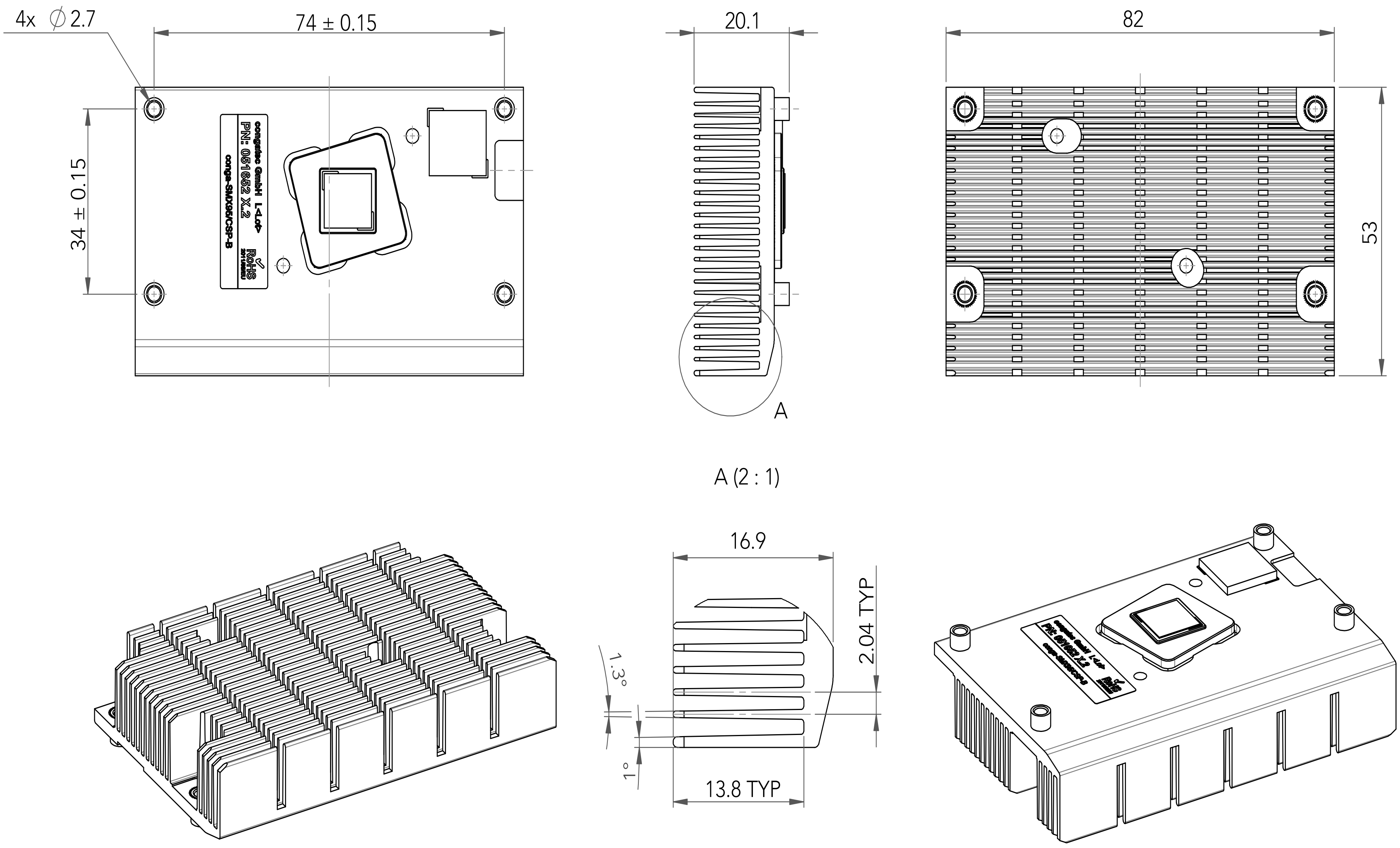
Note

1. *We recommend a maximum torque of 0.45 Nm for carrier board and module mounting screws.*

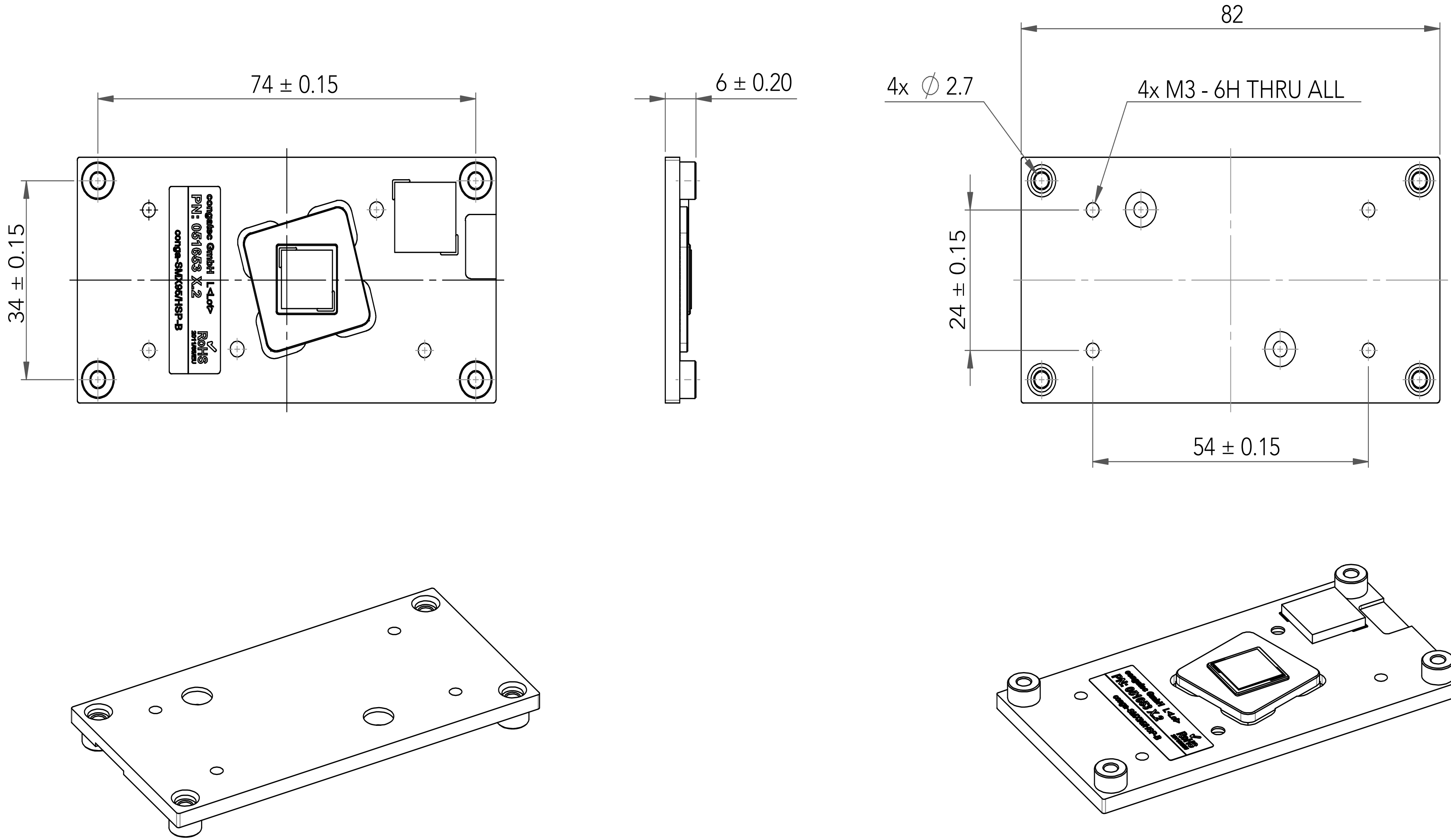
2. *The gap pad material used on congatec heatspreaders may contain silicon oil that can seep out over time depending on the environmental conditions it is subjected to. For more information about this subject, contact your local congatec sales representative and request the gap pad material manufacturer's specification.*

3. *Do not exceed the recommended maximum torque. Doing so may damage the module or the carrier board, or both.*

4.1 CSP Dimensions



4.2 HSP Dimensions



5 Connector Rows

The conga-SMX95 has 314 edge fingers that mate with the MXM3 connector located on the carrier board. This connector is able to interface the signals of the conga-SMX95 with the carrier board peripherals.

5.1 Display Interfaces

The conga-SMX95 supports up to three displays: Up to two LVDS displays, one HDMI® display. DP support can be added instead of the HDMI® support as a BOM option.

5.1.1 HDMI®

conga-SMX95 supports one HDMI® connection in the default configuration. HDMI® support is provided via a Lontium™ LT9611UXC DSI-to-HDMI® bridge connected on the SMARC-HDMI/DP1 pin.

5.1.2 DisplayPort (DP)

conga-SMX95 can support one DisplayPort (DP) connection as a customized variant with BOM change [1]. In such customized variants, DP support is implemented by default using the TI™ SN65DSI86 DSI-to-DP bridge.

Note

1. *PN: 051612 features TI™ SN65DSI86 DSI to DisplayPort bridge by default in place of the DSI-to-HDMI® bridge.*

5.1.3 LVDS/DSI

conga-SMX95 offers LVDS[0:1] pins for one dual channel LVDS display or two independent single channel LVDS displays. Alternatively, the LVDS1 pin can be used as SMARC DSI1 as a custom modification.

Note

If none of the bridges are populated, the LVDS1 pin functions as the DSI1 connected with MIPI DSI1.

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5.2 Camera Inteface (MIPI CSI)

The conga-SMX95 in the default configuration offers CSI[0:1] pins for up to two MIPI CSI-2 camera interfaces by default:

- CSI0 offers two lanes (up to 2.5 Gbps/lane)
- CSI1 offers four lanes (up to 2.5 Gbps/lane)

Note

CSI0 pin is shared with MIPI DSI. If MIPI-CSI is selected, the MIPI-DSI, DisplayPort, and HDMI® outputs will not be available.

5.3 SDIO Card (4 bit) Interface

The conga-SMX95 offers SDIO pins for one SD/SDIO card interface in the default configuration. On customized variants with the optional Wi-Fi®/Bluetooth® module, this module is also routed through the SDIO interface. This interface supports:

- SD/SDIO specification 3.0
- 200 MHz SDR signaling for up to 100 MBps
- Secure Digital eXtended Capacity (SDXC™) cards
- UHS-I @SDR 104/50 and DDR50 [1]
- Default Mode and High Speed Mode

Note

[1.] *UHS-I support is disabled in the congatec software (kernel and bootloader) by default. Check if your carrier board supports UHS-I before enabling it.*

5.4 SPI

The conga-SMX95 features an onboard SPI Flash. Additionally, the conga-SMX95 offers one external SPI Flash and one QSPI Flash on the carrier board.

Note

1. *The FlexSPI port cannot operate the onboard and external QSPI flashes simultaneously, only one QSPI flash can be used at a time by selecting via the CS pins.*
2. *The on-module SPI flash is a Winbond® 128M/1V8 by default, and can be upgraded to 256M-Flash with a BOM change.*

5.5 Audio (I2S)

The conga-SMX95 offers I2S0 and I2S2 pins for up to two Inter-IC Sound (I^2S) buses.

Note

I2S0 may be connected to the HDMI® bridge or the Wi-Fi® module in variants that feature them. SMARC I2S0 is not available on the carrier board in such variants.

5.6 I2C Interfaces

The conga-SMX95 offers the Inter-Integrated Circuit (I2C) buses as defined in the SMARC Hardware Specification 2.2. The buses support the recommended multi-master capability and data rates of 100 kHz and 400 kHz.

The I^2C device addresses are listed in the table below:

Table 9 I2C Interfaces

Port	Device	Address
I2C1	PMIC PF0900 PMIC PF5302 PMIC PF5301 IO Expander PCAL6408A IO Expander PCAL6408A	0x08 0x2E 0x2A 0x20 0x21
I2C2	RTC	0x68
I2C3	SMARC-I2C_PM	
I2C4	SMARC-I2C_GP IO Expander PCAL6416A IO Expander PCAL6408A	 0x20 0x21
I2C5	SMARC-I2C_CSI1 SMARC-I2C_LCD IO Expander PCAL6416A	 0x20
I2C6	SMARC-I2C_CSI0 DSI-DP bridge IO Expander PCAL6408A DSI-HDMI bridge	 0x2C 0x21 0x2B

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5.7 Serial Ports

The conga-SMX95 offers SER[0:2] pins for three asynchronous serial ports by default. Each port supports programmable baud rates of up to 4 Mbps. SER0 and SER2 support handshaking.

Note

1. *SMARC SER1 is connected to the SoC-UART3 and can optionally be used as the Cortex™-M7 console connection.*
2. *SMARC SER2 is not available on variants with Wi-Fi® module.*
3. *SMARC SER3 is not connected.*

5.8 CAN Bus

The conga-SMX95 offers CAN[0:1] pins for up to two CAN buses. Each bus supports the CAN FD and CAN 2.0B protocols.

Note

Driving the CAN1 bus may not be directly possible on Yocto Project™ and Android™.

5.9 USB® Interfaces

The conga-SMX95 offers pins for five USB® ports by default. The USB[1:4] pins are connected via a TI™ TUSB8041 USB® 3.0 hub and provides four ports[1]. USB0 is directly routed to the SoC and is used for SDP connection. *USB5 is not connected.*

Note

[1] *Although the TI™ TUSB8041 hub supports four USB® 3.0 ports, only up to two ports shall be utilized as USB® 3.0.*

5.10 PCI Express™

The conga-SMX95 offers PCIE_A and PCIE_B interfaces for two PCI Express™ x1 Gen3 buses with a transfer rate of up to 8 GT/s. *The CLK-Generator DSC557 features an integrated MEMS oscillator but does not support spread-spectrum clocking.*

Note

1. *In customized variants with 10 GbE support, SERDES lanes routed to PCIE_C interface support the 10 GbE port.*
2. *PCIE_D is not connected.*

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5.11 Ethernet®

The conga-SMX95 offers GBE[0:1] pins for two Gigabit Ethernet® interfaces via two onboard TI™ DP83867 Physical Layers (PHYs) with support for Time Sensitive Networking (TSN) and IEEE® 1588. Optionally, conga-SMX95 can support one 10GbE port routed through PCIE_C interface (assembly option).

Note

Ethernet® interfaces on conga-SMX95 utilize a shared MDIO bus for PHY management in the default configuration.

5.12 GPIO

The conga-SMX95 offers GPIO[0:13] pins for 14 GPIOs as defined in the SMARC Hardware Specification 2.2.

The GPIO[1:4] pins are provided via a PCAL6416A GPIO expander with the I²C address 0x20 on I2C5.

The GPIO[7:13] pins are provided via a PCAL6416A GPIO expander with the I²C address 0x20 on I2C4.

The other GPIO pins have been directly connected to the SoC. The connection of all these pins are shown in the below table.

Table 10 Connection Description for GPIO Pins Directly Connected on the SoC

SMARC GPIO	Connection on the SoC
0	GPIO expander (I2C5)
1	GPIO expander (I2C5)
2	GPIO expander (I2C5)
3	GPIO expander (I2C5)
4	GPIO expander (I2C5)
5	GPIO_IO19
6	GPIO_IO18
7	GPIO expander (I2C4)
8	GPIO expander (I2C4)
9	GPIO expander (I2C5)
10	GPIO expander (I2C5)
11	GPIO expander (I2C5)
12	GPIO expander (I2C5)
13	GPIO expander (I2C5)

Note

1. *GPIO5 and GPIO6 can be used for fan control using PWM and TACHIN signals directly driven from the SoC.*
2. *For further details, refer the section 7 "Signal Descriptions and Pinout Tables"*

5.13 Boot Select

BOOT_SEL[0:2]#

The boot source can be selected via the SMARC connector pins BOOT_SEL[0:2]# as described in the table below: [1]

BOOT_SEL			Selected Boot Source
2#	1#	0#	
Ground	Ground	Ground	Internal Fuses
Ground	Float	Ground	eMMC™ 5.1
Ground	Float	Float	SD card
Float	Ground	Ground	Flex-SPI NOR (default) [3]

On the conga-SEVAL evaluation carrier board, the boot source can be selected via DIP switches M17 and M18 as described in the table below:

M17		M18	Selected Boot Source
#1	#2	#1	
ON	ON	OFF	SPI flash (default) [3]
OFF	OFF	ON	SD card

The OS boot device is defined via the U-Boot environment variables. For more information, refer to the conga-SMX95 online software documentation at https://wiki.congatec.com.

Note

1. *The available boot sources and their selection via BOOT_SEL[0:2]# pins corresponds with the boot mode options and configuration pins defined by NXP®. Therefore, select the desired boot source according to this table instead of the SMARC 2.2 specification.*
2. *The Serial Download Mode can only be selected by setting the FORCE_RECOV# pin low. For normal operation, ensure this pin is not floating.*
3. *The pre-compiled binaries from congatec only support SPI flash as the boot source.*

FORCE_RECOV#

Low on the FORCE_RECOV# pin enables the Serial Download Mode regardless of the selected boot source via the BOOT_SEL[0:2]# pins. For normal operation, ensure this pin is not floating. The program image can be downloaded over the USB0 port (see section 5.9 “USB® Interfaces”).

On the conga-SEVAL evaluation carrier board, set the jumper X45 to position 2-3 to enable the Serial Download Mode. For normal operation, ensure the jumper X45 is set to the default position 1-2.

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5.14 Power Control

The module operates within an input voltage range of 5 V. The power-up sequence is described below:

1. The carrier board provides the input voltage (VDD_IN) to the module.
2. If VIN_PWR_BAD# is not driven low, the module enables its power circuits.
3. After the first VIN power on, the module starts the power-up sequence.
4. The module enables the carrier board power by asserting CARRIER_PWR_ON (SUS_S5#) and CARRIER_STBY# (SUS_S3#).
5. The module releases RESET_OUT# and starts the boot process.

The power control signals are described below:

VIN_PWR_BAD#

VIN_PWR_BAD# (pin S150) is an active-low input signal. It indicates that the input voltage to the module is either not ready or out of specified range. Carrier board hardware should drive this signal low until the input power is up and stable. Releasing VIN_PWR_BAD# too early can cause numerous boot up problems. The module has a 10k pull up resistor to VDD_IN.

CARRIER_PWR_ON

CARRIER_PWR_ON (pin S154) is an active-high output signal. The module asserts this signal to enable power supplies for devices connected to the carrier board.

CARRIER_STBY#

The CARRIER_STBY# signal (pin S153) is an active-low output that can be used to indicate that the module is going into suspend state, where the A55 core power is turned off.

RESET_IN#

The RESET_IN# signal (pin P127) is an active-low input signal from the carrier board. The signal may be used to force the module to reset.

RESET_OUT#

The RESET_OUT# signal (pin P126) is an active-low output signal from the module. The module asserts this signal during the power-up sequencing to allow the carrier board power circuits to come up. The module deasserts this signal to begin the boot-up process.

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POWER_BTN#

The POWER_BTN# (pin P128) is an active-low power button input from the carrier board. This power button signal is used to wake the system. Driving this signal low for at least 5 seconds powers off the system immediately.

Power Supply Implementation Guidelines

The operational power source for the conga-SMX95 is 5V. The remaining necessary voltages are internally generated on the module with onboard voltage regulators.

A carrier board designer should be aware of the important information below when designing a power supply for a conga-SMX95 application:

- We have noticed that on some occasions, problems occur when using a 5V power supply that produces non monotonic voltage when powered up. The problem is that some internal circuits on the module (e.g. clock-generator chips) generate their own reset signals when the supply voltage exceeds a certain voltage threshold. A voltage dip after passing this threshold may lead to these circuits becoming confused, thereby resulting in a malfunction. This problem though rare, has been observed in some mobile power supply applications. The best way to ensure that this problem is not encountered is to observe the power supply rise waveform through an oscilloscope. This will help to determine if the rise is indeed monotonic and does not have any dips. You should do this during the power supply qualification phase to ensure that the problem does not occur in the application.

Inrush and Maximum Current Peaks on VDD_IN

The maximum peak-current on the conga-SMX95 VDD_IN (5V) power rail has not yet been determined and will be specified in a future release of this document.

Note

For more information about power control event signals, refer to the SMARC 2.2 specification.

6 Onboard Interfaces and Devices

6.1 DRAM®

The conga-SMX95 offers up to 16 GB 32 bit LPDDR5 onboard SDRAM® @ 6400 MT/s. The memory size of each conga-SMX95 variant is listed in section 1.2.1 “Options Information”.

6.2 eMMC™

The conga-SMX95 offers an onboard eMMC™ 5.1 HS400 storage device of up to 64 GB by default. Changes to the onboard eMMC™ may occur during the lifespan of the module in order to keep up with the rapidly changing eMMC technology. The performance of the newer eMMC™ may vary depending on the eMMC™ technology.

Note

1. *For adequate operation of the eMMC™, ensure that at least 15 % of the eMMC™ storage is reserved for vendor-specific functions.*

2. *Only the SDHC1 interface supports the eMMC™ HS400 device.*

6.3 Wi-Fi® and Bluetooth®

Optionally, the conga-SMX95 offers Wi-Fi® and Bluetooth® connectivity via an onboard Sona™ NX611 Wi-Fi® + Bluetooth® module from EZURIO™ (assembly option).[1]

The Sona™ NX611 Wi-Fi® + Bluetooth® module is connected via the SDIO (SDIO3 4 bit) interface, I2C6 on GPIO Expander and Bluetooth® via SoC_UART5. SMARC SER2 is not available on the carrier board in variants featuring the Wi-Fi® + Bluetooth® module.

If the HDMI® bridge is stuffed, audio is not available via Bluetooth®.

Note

[1] *PN: 051620 offers Wi-Fi®/BT by default.*

6.4 RTC

The conga-SMX95 offers a discrete Real-Time Clock (RTC) via an onboard MicroCrystal® RV-4162-C7 module in the default configuration on I2C2 with the I²C device address 0x68. Alternate stuffing with MicroCrystal® RV-8803 is possible through BOM change (assembly option). [1]

Note

1. *In the alternate stuffing with MicroCrystal® RV-8803, the* I²C device address is 0x32.

6.5 Console and Debug Interfaces

6.5.1 A55 and M33 Console

The conga-SMX95 offers a Cortex™-A55 and Cortex™-M33 console for debugging via the onboard connector X2.

The connector pinout is described in the table below:

Table 11 X2 Pinout Description

Pin	SoC Ball	Description
1	UART2_TXD	M33 Console: TXD via tranceiver ISL3243E
2	+VIN	SMARC VDD_IN (+5 V)
3	GND	Ground
4	UART1_TXD	A55 Console: TXD via tranceiver ISL3243E
5	UART1_RXD	A55 Console: RXD via tranceiver ISL3243E
6	UART2_RXD	M33 Console: RXD via tranceiver ISL3243E

Connector Type

X2: Molex® PicoBlade 0532610671 (6 Circuits, 1.25mm Pitch, Right-Angle, Friction Lock)
Mates with Molex® PicoBlade Cable Assembly Series 15134 with 6 Circuits
For a matching cable with two D-SUB 9 connectors, see Table 3.

6.5.2 JTAG™ Debug

Optionally, the conga-SMX95 can offer an onboard JTAG™ debug interface (X1) (assembly option / header is not stuffed in the default configuration).

The connector pinout is described in the table below:

Table 12 Optional JTAG™ Debug Connector (X1) Pinout Description

Pin	Pin	Description
1	JTAG_VTREF	+1.8V sourced by Module
2	JTAG_TMS	JTAG™ mode select
3	GND	Ground
4	JTAG_TCLK	JTAG™ clock
5	GND	Ground
6	JTAG_TDO	JTAG™ data out
7	JTAG_RTCLK	Not connected
8	JTAG_TDI	JTAG™ data in
9	JTAG_TRST#	Not used
10	JTAG_SRST#	System Reset, active low

Connector Type

X1: 5x2 Pin Header, 1.27 mm Pitch

Note

Test Access Port Controller Reset (TRST) can be performed via Test Mode Select (TMS) signalling.

7 Signal Descriptions and Pinout Tables

Click on the screenshot or link below to directly download the conga-SMX95 pinout as an Excel file:

X3A + X3B - SMX95 SMARC edge connection

SMX95 Interface	i.MX95 Ball Name	i.MX95 BGA716 Ball	SMARC connection	SMARC Pin Name	SMARC Pin	
n.c. - not supported	#N/A			SMB_ALERT	P1	Expander U55 (Addr 0x20; I2C4), P1.6
SMARC CSI1 MIPI-CSI 4ch	GPIO_IO01	J51		CSI1_TX+ / I2C_CAM1_CK	S1	MIPI-CSI-camera (4-lane) - I2C5
GND	#N/A			GND	P2	
SMARC CSI1 MIPI-CSI 4ch	GPIO_IO00	J49		CSI1_TX- / I2C_CAM1_DAT	S2	MIPI-CSI-camera (4-lane) - I2C5
SMARC CSI1 MIPI-CSI 4ch	MIPI_CSI1_CLK_P	E15		CSI1_CK+	P3	MIPI-CSI-camera (4-lane)
GND	#N/A			GND	S3	
SMARC CSI1 MIPI-CSI 4ch	MIPI_CSI1_CLK_N	F16		CSI1_CK-	P4	MIPI-CSI-camera (4-lane)
n.c. - reserved	#N/A		NC	RSVD	S4	not connected
SMARC Gigabit Ethernet 1 - Trigger - connected to GPIO1 of DP83867	#N/A			GBE1_SDP	P5	GPIO1 from Ethernet PHY 2 (DP83867)
SMARC CSI1 MIPI-CSI 2ch	GPIO_IO03	K52		CSI0_TX- / I2C_CAM0_CK	S5	MIPI-CSI-camera (2-lane) - I2C6
SMARC Gigabit Ethernet 0 - Trigger - connected to GPIO1 of DP83867	#N/A			GBE0_SDP	P6	GPIO1 from Ethernet PHY 1 (DP83867)
SMARC CSI1 MIPI-CSI 4ch	CCM_CLKO1	AH20		CAM_MCK	S6	MIPI-CSI-camera - MCLK
SMARC CSI1 MIPI-CSI 4ch	MIPI_CSI1_D0_P	E19		CSI1_RX0+	P7	MIPI-CSI-camera (4-lane)
SMARC CSI1 MIPI-CSI 2ch	GPIO_IO02	K48		CSI0_TX+ / I2C_CAM0_DAT	S7	MIPI-CSI-camera (2-lane) - I2C6
SMARC CSI1 MIPI-CSI 4ch	MIPI_CSI1_D0_N	F20		CSI1_RX0-	P8	
SMARC CSI1 MIPI-CSI 2ch	#N/A	B10		CSI0_CK+	S8	switching option: MIPI-CSI-camera (2-lane)
GND	#N/A			GND	P9	
SMARC CSI1 MIPI-CSI 2ch	MIPI_DSICSI1_CLK_N	C11		CSI0_CK-	S9	switching option: MIPI-CSI-camera (2-lane)
SMARC CSI1 MIPI-CSI 4ch	MIPI_CSI1_D1_P	E17		CSI1_RX1+	P10	MIPI-CSI-camera (4-lane)
GND	#N/A			GND	S10	
SMARC CSI1 MIPI-CSI 4ch	MIPI_CSI1_D1_N	D18		CSI1_RX1-	P11	MIPI-CSI-camera (4-lane)
SMARC CSI1 MIPI-CSI 2ch	MIPI_DSICSI1_D0_P	B14		CSI0_RX0+	S11	switching option: MIPI-CSI-camera (2-lane)

https://git.congatec.com/arm-nxp/imx9-family-ea/doc/cgtimx95_pinlist/-/blob/cgtsx95_pinlist/cgtsx95_pin_connection.xlsx

Alternatively, you can find the conga-SMX95 pinout by selecting it from the drop-down list at:

https://git.congatec.com/arm-nxp/imx9-family-ea/doc/cgtimx95_pinlist/tree/master

The SMARC signals are described in the SMARC 2.2 Hardware Specification publicly available at:

https://sget.org

The SoC documentation is available at:

https://www.nxp.com

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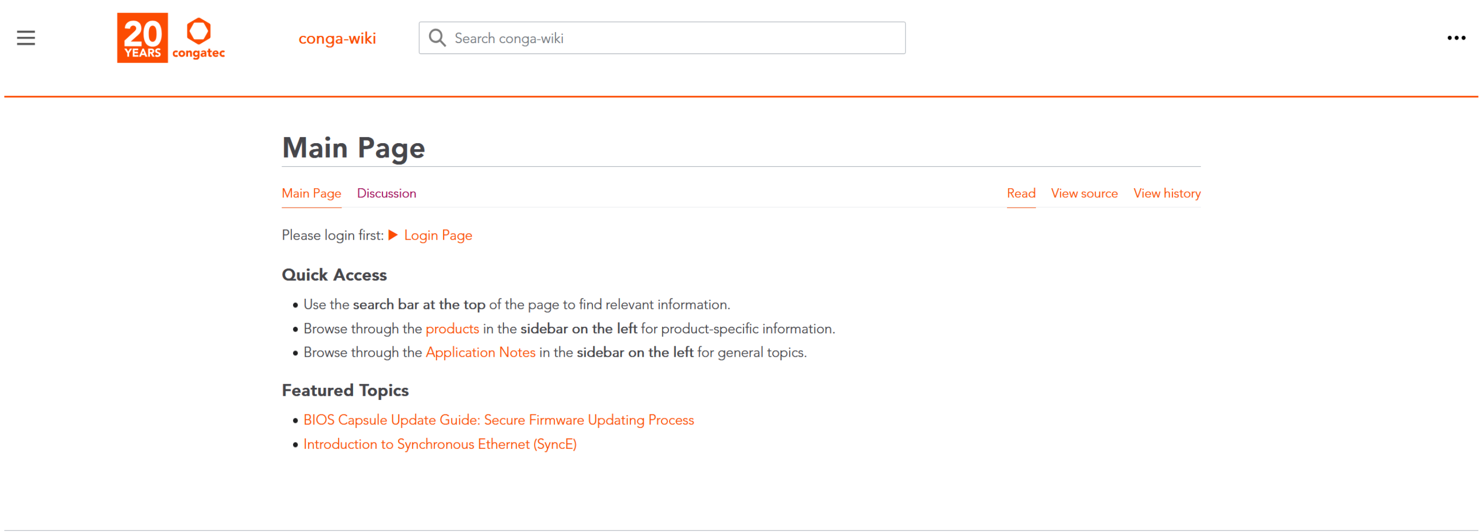
8 Software Documentation

Click on the screenshot or link below to open the conga-SMX95 software documentation in your browser:



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