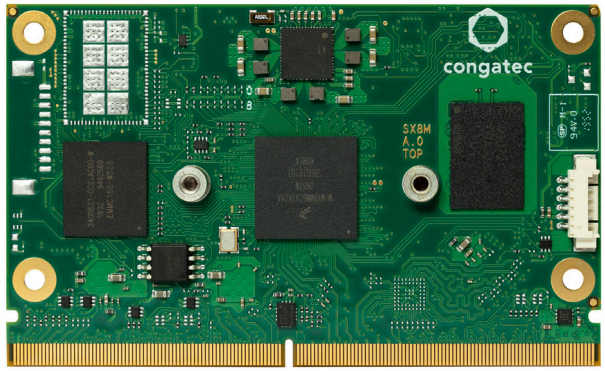

conga-SMX8-Mini

SMARC 2.1 Module with NXP® i.MX 8M Mini Quad, Dual and Solo Processors

User's Guide

Revision 1.5

Revision History

Revision	Date (yyyy-mm-dd)	Author	Changes
0.1	2020-02-13	BEU	• Preliminary release
1.0	2020-06-05	BEU	• Changed document to read from i.MX8 M Mini Reference Manual to Datasheet in preface section • Added power consumption values to table 6 and 7 • Updated block diagram in section 3 “Block Diagram” • Updated section 7 “Signal Descriptions and Pinout Tables” and 8 “Software Documentation”
1.1	2021-05-14	BEU	• Added inrush current to section 5.13 “Power Control”
1.2	2021-07-06	BEU	• Updated congatec AG to congatec GmbH throughout the document • Added Software License Information to preface section
1.3	2021-08-03	BEU	• Changed specification of the module from SMARC 2.0 to SMARC 2.1 throughout the document
1.4	2022-10-25	BEU	• Updated number of GPIOs and RTC information in table 4 “Feature Summary” • Updated GBE0 support from IEEE1588 to IEEE 1588v2 in table 4 “Feature Summary” and section 5.10 “Ethernet” • Updated section 2.5 “Power Consumption” • Updated section 3 “Block Diagram” • Added UHS-I voltage information to section 5.3 “SD/SDIO Card Interface” • Updated SPI0, SPI1 and SPI0_CS1# information in section 5.4 “SPI Interfaces” • Updated Wi-Fi and Bluetooth combo module in section 5.7 “Serial Ports” and 5.8 “USB Ports” • Addeded notes about PCIE_A_CKREQ# implementation in different revisions to section 5.9 “PCI Express™” • Corrected note 4 in section 5.9 “PCI Express™” • Updated onboard PHY to TI DP83867 in section 5.10 “Ethernet” • Added note about onboard PHY of older revisions to section 5.10 “Ethernet” • Updated number of GPIOs to fourteen in section 5.11 “GPIO” • Added note about number of GPIOs of older revisions to section 5.11 “GPIO” • Minor improvements in section 5.12 “Boot Select” and 5.13 “Power Control” • Added RESET_OUT# information in section 5.13 “Power Control” • Renamed section 6.3 “SPI NOR Flash” to “QSPI NOR Flash Memory” • Renamed “SPI” to “QSPI” in table 4 “Feature Summary” and section 6.3 “QSPI NOR Flash Memory” • Updated optional max. memory size in table 4 “Feature Summary” and section 6.3 “QSPI NOR Flash Memory” • Added note about optional max. memory size of older revisions to section 6.3 “QSPI NOR Flash Memory” • Updated optional Wi-Fi and Bluetooth modules in section 6.4 “Wi-Fi and Bluetooth” • Added note about optional Wi-Fi and Bluetooth module of older revisions to section 6.4 “Wi-Fi and Bluetooth” • Updated onboard RTC in section 6.5 “RTC” • Added note about onboard RTC of older revisions to section 6.5 “RTC”
1.5	2024-01-02	BEU	• Updated title page • Updated RoHS Directive • Added note to section 2.7 “Environmental Specifications” • Added note to section 4 “Cooling Solutions”

Preface

This user's guide provides information about the components, features and connectors available on the conga-SMX8-Mini. 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-SMX8-Mini Pinout Description (https://git.congatec.com/arm-nxp/imx8-family/doc/cgtimx8_pinlist/tree/cgtsx8m_pinlist)
SMARC® Design Guide 2.0 (https://sget.org)
SMARC® Specification 2.1 (https://sget.org)
i.MX 8M Mini Applications Processor Datasheet (www.nxp.com)

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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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Terminology

Term	Description
°C	Degrees Celsius
µA	Microamp
µs	Microsecond
A	Ampere
AN	Application Note
ARM	Advanced RISC Machine
CAAM	Cryptographic Acceleration and Assurance Module
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
DP	DisplayPort
DP++	DisplayPort Dual-Mode
DRAM	Dynamic Random Access Memory
DSI	Display Serial Interface
D-SUB	D-Subminiature
eMMC	embedded MultiMediaCard
eSPI	enhanced Serial Peripheral Interface
GB	Gigabyte
GbE	Gigabit Ethernet
GHz	Gigahertz
GND	Ground
GPIO	General-Purpose Input/Output
GPU	Graphics Processing Unit
GTps	Gigatransfers per second
HW	Hardware
HAB	High Assurance Boot
HSP	Heat Spreader
Hz	Hertz
I/O	Input/Output
I²C	Inter-Integrated Circuit
I²S (I2S)	Inter-IC Sound
IEEE	Institute of Electrical and Electronics Engineers
JEIDA	Japan Electronic Industries Development Association
JTAG	Joint Test Action Group
KS	Key State
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
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
UART	Universal Asynchronous Receiver-Transmitter
U-Boot	Universal Boot Loader
UHS	Ultra High Speed
USB	Universal Serial Bus
uSDHC	ultra Secure Digital Host Controller
V	Volt
Vdc	Volts direct current
VESA	Video Electronics Standards Association
W	Watt
Wi-Fi	Wireless Fidelity

Contents

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-SMX8-Mini

The conga-SMX8-Mini is based on the SMARC 2.1 Specification and features an NXP® i.MX 8M Mini Quad, Dual or Solo applications processor. The conga-SMX8-Mini is a low power module with high computing performance and outstanding graphics. Additionally, the conga-SMX8-Mini supports 32 bit LPDDR4-3000 SDRAM with up to 4 GB capacity, multiple I/O interfaces, and one display.

By offering most of the functional requirement for any SMARC application, the conga-SMX8-Mini provides manufacturers and developers with a platform to jump-start the development of systems and applications based on SMARC specification. Its features and capabilities make it an ideal platform for designing compact, energy-efficient, performance-oriented embedded systems.

1.2.1 Options Information

The conga-SMX8-Mini is available in nine variants (five commercial and four industrial). The tables below show the different configurations available.

Table 1 Commercial Variants

Part-No	051200	051201	051202	051203	051204
Processor	i.MX 8M Mini Quad	i.MX 8M Mini Dual	i.MX 8M Mini Solo	i.MX 8M Mini Quad	i.MX 8M Mini Quad
Cortex®-A53	4x 1.8 GHz	2x 1.8 GHz	1x 1.8 GHz	4x 1.8 GHz	4x 1.8 GHz
SDRAM	4 GB LPDDR4-3000	2 GB LPDDR4-3000	1 GB LPDDR4-3000	2 GB LPDDR4-3000	4 GB LPDDR4-3000
Display Interface	Dual channel LVDS	Dual channel LVDS	Dual channel LVDS	Dual channel LVDS	DisplayPort

Table 2 Industrial Variants

Part-No	051220	051221	051222	051223
NXP Processor	i.MX 8M Mini Quad	i.MX 8M Mini Dual	i.MX 8M Mini Solo	i.MX 8M Mini Quad
Cortex®-A53	4x 1.6 GHz	2x 1.6 GHz	1x 1.6 GHz	4x 1.6 GHz
SDRAM	4 GB LPDDR4-3000	2 GB LPDDR4-3000	1 GB LPDDR4-3000	2 GB LPDDR4-3000
Display Interface	Dual channel LVDS	Dual channel LVDS	Dual channel LVDS	Dual channel LVDS

1.2.2 Accessories

Table 3 conga-SMX8-Mini Adapters

Part-No	48000023
Product	RS-232 adapter cable for conga-ARM modules
Description	Adapter cable for ARM console. MOLEX PicoBlade 6 circuit to two D-SUB 9 connectors.

2 Specifications

2.1 Feature List

Table 4 Feature Summary

Form Factor	SMARC® form factor specification, revision 2.1 (82 mm x 50 mm)	
SoC	NXP® i.MX 8M Mini Quad, Dual or Solo	
Memory	1, 2 or 4 GB onboard 32 bit LPDDR4-3000 SDRAM	
Storage	QSPI NOR flash memory with up to 256 Mbit (64 Mbit assembled by default) eMMC™ 5.1 HS400 with up to 128 GB (16 GB assembled by default)	
Audio	2x I²S	
Ethernet	1x Gigabit Ethernet with support for IEEE 1588v2	
Display Interfaces	Support for one display with max. resolution of 1920x1080 @ 60 Hz: 1x Dual Channel LVDS (default)[1] or 1x DSI (assembly option) or 1x DP (assembly option)[1]	**NOTE**: 1 *PN 051204 supports DP by default instead of LVDS (Table 1).*
Peripheral Interfaces	1x MIPI CSI with two lanes (default) or four lanes (assembly option) 1x SD/SDIO Card Interface 1x SPI (SPI0) 1x SPI (SPI1) instead of onboard QSPI NOR flash (assembly option) 2x I²C 3x Serial Ports 5x USB 2.0 (USB0 supports OTG) 1x PCI Express x1 Gen2	14x GPIOs (additional GPIOs are possible via unused signals) 1x Onboard JTAG Debug Connector (assembly option) 1x Onboard A53 Console Connector[1] 1x Onboard M4 Console Connector[1] instead of serial port SER1 (assembly option) 1x Onboard Wi-Fi and Bluetooth M.2 1216 Module (assembly option) **NOTE**: 1 *Requires RS-232 adapter cable 48000023 (Table 3). A53 and M4 Console are provided on the same onboard connector but only A53 Console is supported by default.*
Features	Watchdog timer	Discrete micropower Real-Time Clock (RTC)
Bootloader	U-Boot	
Virtualization	Multiple domains with hardware virtualization Multiple Operating Systems	System MMU Resource partitioning and split GPU
Security	High Assurance Boot (HAB) TrustZone®	Cryptographic Acceleration and Assurance Module (CAAM)

2.2 Supported Operating Systems

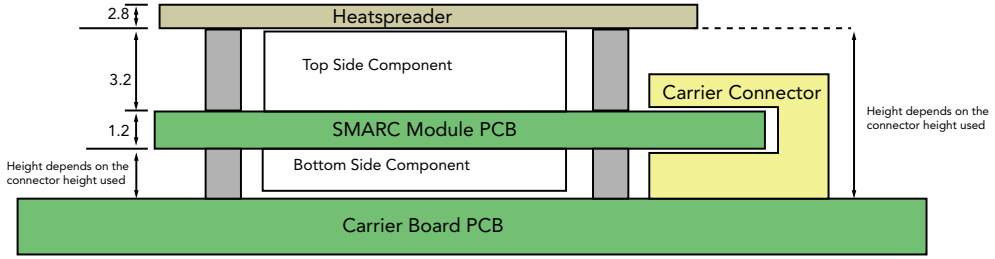
The conga-SMX8-Mini supports the following operating systems:

- 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:

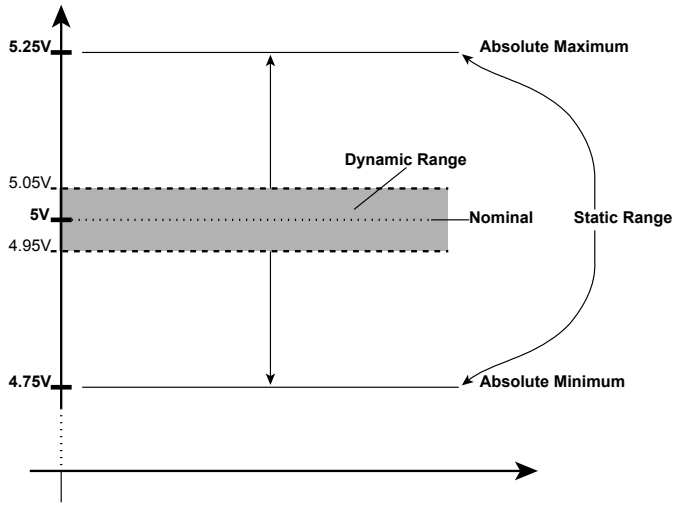


All dimensions are in millimeters

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 minimum slope of 250 V/s. 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.

2.5 Power Consumption

The power consumption values were measured with the following setup:

- Input voltage +5 V
- conga-SMX8-Mini
- conga-SEVA carrier board
- conga-SMX8-Mini cooling solution

The power consumption values were recorded during the modes described in the table below:

Table 5 Measurement Description

Mode	Description	Comment
Suspend	Lowest power state with external supplies on	For more information about these use-cases, refer to the AN12410 "i.MX 8M Mini Power Consumption Measurement" available on the NXP website www.nxp.com.
Idle	IDLE_DEFAULT without display	
100%	100% CPU and GPU workload	The CPU and GPU were stressed to their maximum frequency with stress-ng and Glmark2.
Peak	100% CPU and GPU workload at ~100°C peak power consumption	Consider this value when designing the system's power supply to ensure that sufficient power is supplied during worst case scenarios.

The table below provides the power consumption values of each conga-SMX8-Mini variant for different operating modes:

Table 6 Power Consumption Values

PN	Memory Size	HW Revision	U-Boot	OS	SoC	Current (A) @ 5 V			
						Suspend	Idle	100%	Peak
051200	4 GB	A.1	2018.03	Yocto (Sumo)	i.MX 8M Mini Quad	0.07	0.30	0.65	0.78
051201	2 GB	A.1	2018.03	Yocto (Sumo)	i.MX 8M Mini Dual	0.07	0.30	0.54	0.60
051202	1 GB	A.1	2018.03	Yocto (Sumo)	i.MX 8M Mini Solo	0.07	0.29	0.49	0.54
051203	2 GB	A.1	2018.03	Yocto (Sumo)	i.MX 8M Mini Quad	0.07	0.29	0.63	0.72
051204	4 GB	A.1	2018.03	Yocto (Sumo)	i.MX 8M Mini Quad	0.08	0.37	0.73	0.77
051220	4 GB	A.1	2018.03	Yocto (Sumo)	i.MX 8M Mini Quad	0.07	0.31	0.61	0.71
051221	2 GB	A.1	2018.03	Yocto (Sumo)	i.MX 8M Mini Dual	0.07	0.29	0.51	0.58
051222	1 GB	A.1	2018.03	Yocto (Sumo)	i.MX 8M Mini Solo	0.07	0.29	0.47	0.52
051223	2 GB	A.1	2018.03	Yocto (Sumo)	i.MX 8M Mini Quad	0.07	0.30	0.61	0.72

2.6 Supply Voltage Battery Power

Table 7 CMOS Battery Power Consumption

RTC @	Voltage	Current
-10°C	3V DC	1.20 µA
20°C	3V DC	1.27 µA
70°C	3V DC	2.44 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 GmbH website at www.congatec.com/support/application-notes.*
4. *We recommend to always have a CMOS battery present when operating the conga-SMX8-Mini.*

2.7 Environmental Specifications

Temperature (commercial variants)	Operation: 0° to 60°C	Storage: -40° to +85°C
Temperature (industrial variants)	Operation: -40° to 85°C	Storage: -40° to +85°C
Humidity	Operation: 10% to 90%	Storage: 5% to 95%

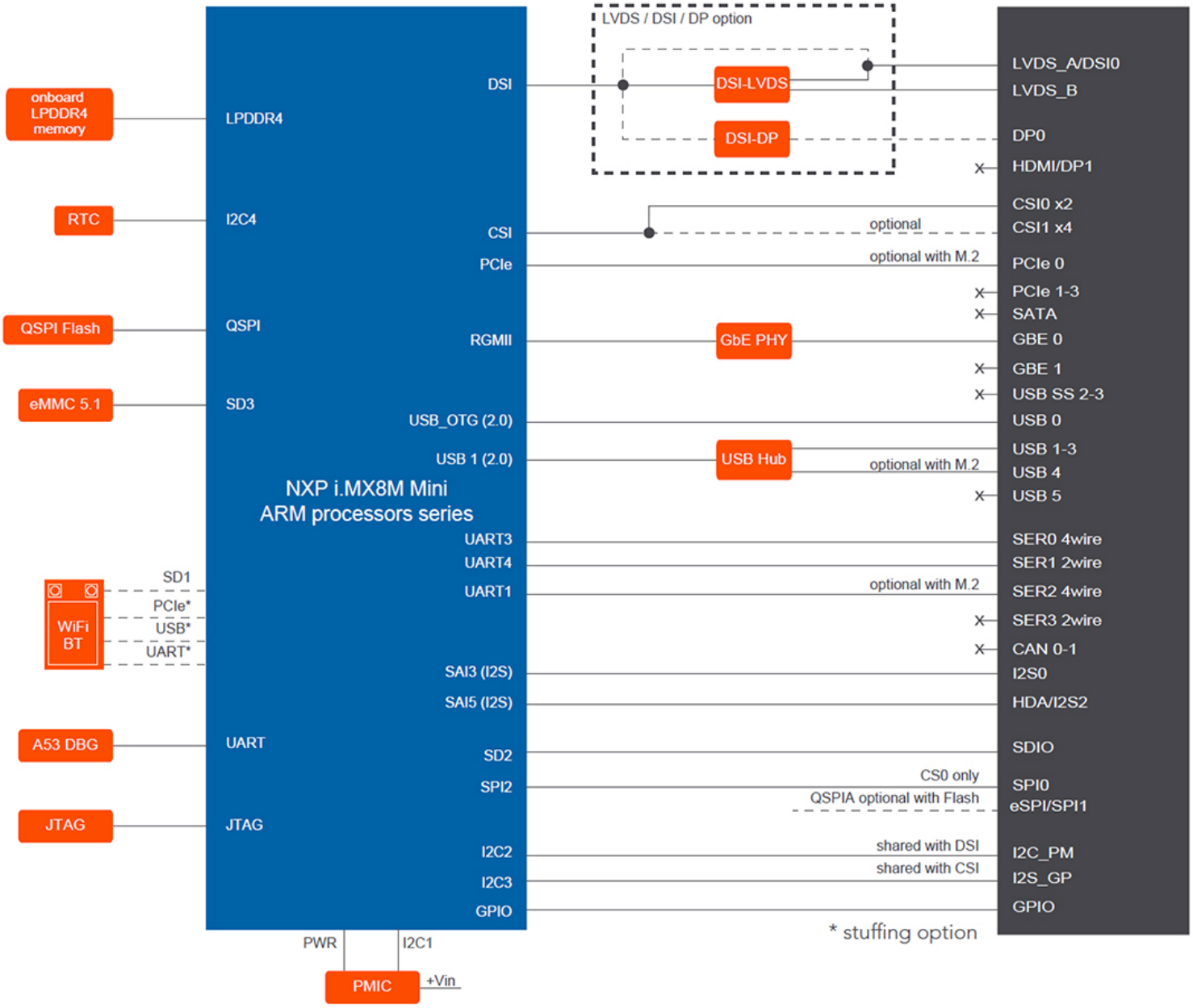
Caution

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

Note

For long term storage of the conga-SMX8-Mini (more than six months), keep the conga-HPC/EVAL-Client 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. We do not recommend storing the conga-SMX8-Mini for more than five years under these conditions.

3 Block Diagram



4 Cooling Solutions

congatec GmbH offers the following cooling solutions for the conga-SMX8-Mini 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	051250	Passive cooling with 2.7 mm borehole standoffs.
2	HSP	051251	Heatspreader with 2.7 mm borehole standoffs.

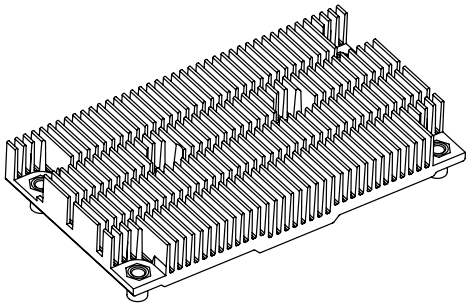
Note

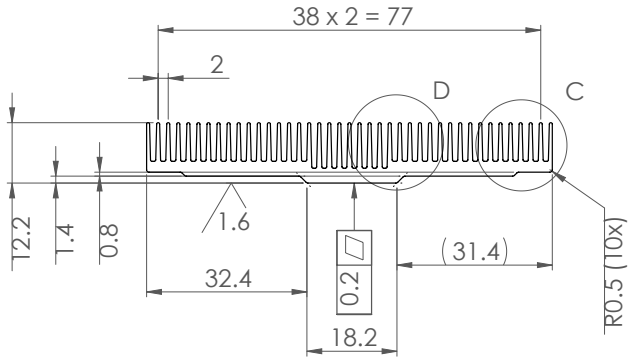
1. *We recommend a maximum torque of 0.4 Nm for carrier board and module mounting screws.*
2. *The gap pad material used on congatec heatspreaders may contain silicon oil that can seep out over time depending on the environmental conditions it is subjected to. For more information about this subject, contact your local congatec sales representative and request the gap pad material manufacturer's specification.*
3. *For optimal thermal dissipation, do not store the congatec cooling solutions for more than six months.*

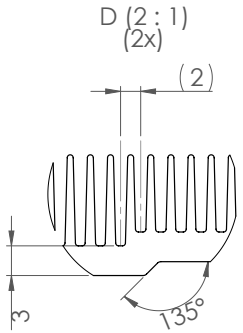
Caution

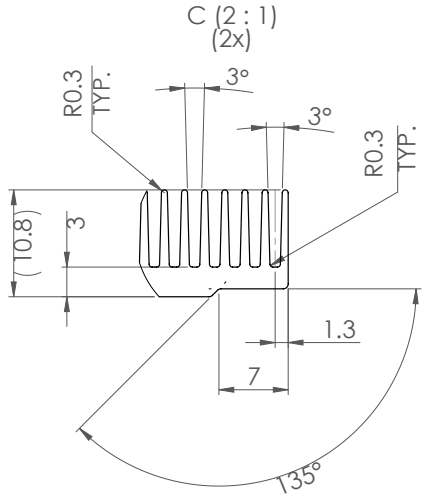
1. *The congatec heatspreaders/cooling solutions are tested only within the commercial temperature range of 0° to 60°C. Therefore, if your application that features a congatec heatspreader/cooling solution operates outside this temperature range, ensure the correct operating temperature of the module 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.*

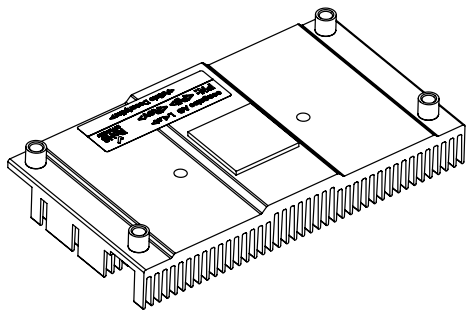
4.1 CSP Dimensions

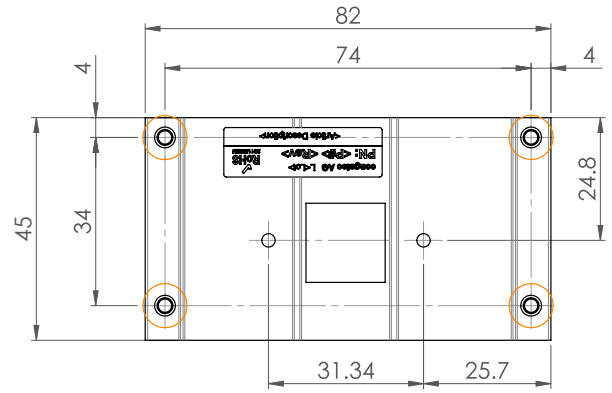


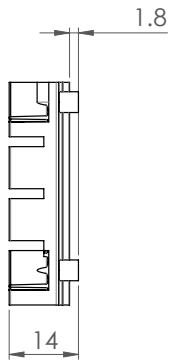






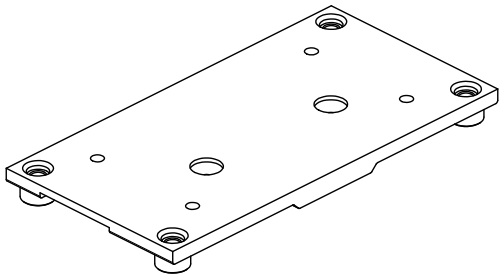


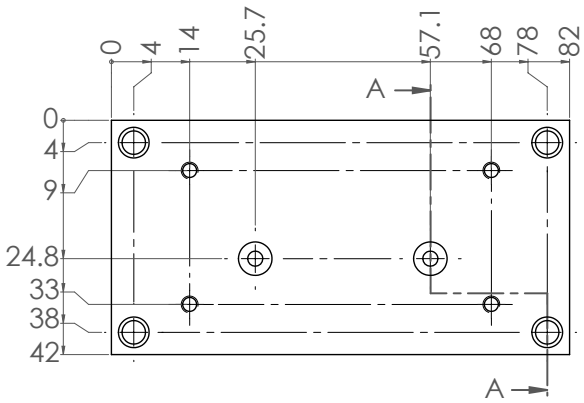


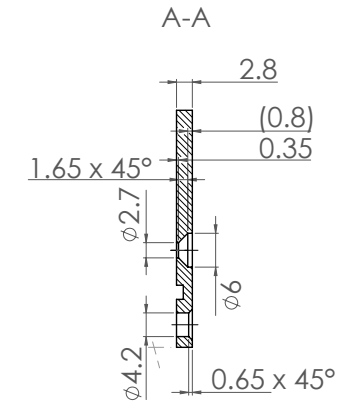


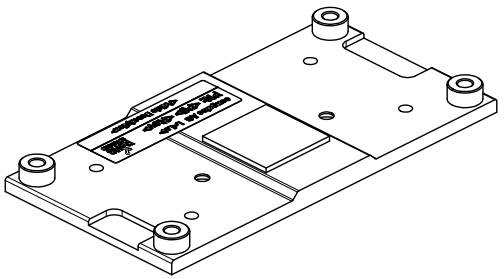
ø2.7 x 6 mm
non-threaded standoff
for borehole version

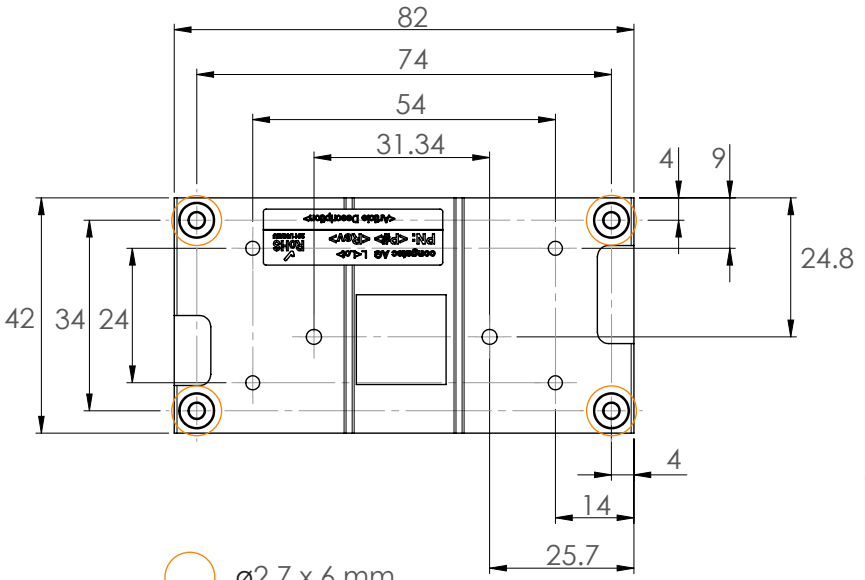
4.2 HSP Dimensions

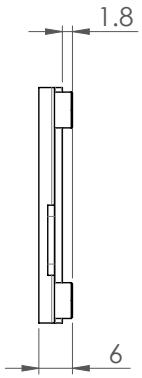












5 Connector Rows

The conga-SMX8-Mini 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-SMX8-Mini with the carrier board peripherals.

5.1 Display Interfaces

The conga-SMX8-Mini supports one display via LVDS, DSI or DP with a maximum resolution of 1920x1080 @ 60 Hz.

5.1.1 LVDS

The conga-SMX8-Mini offers a dual channel LVDS interface (LVDS[0:1])[1] via a TI SN65DSI84 DSI to LVDS bridge with support for 18 and 24 bit JEIDA or VESA mapping by default[2].

Note

1. *Two independent single channel LVDS display panels are not supported.*
2. *PN 051204 offers a DP (DP0) instead of LVDS (Table 1).*

5.1.2 DSI

Optionally, the conga-SMX8-Mini can offer a DSI (DSI0) instead of LVDS (assembly option).

5.1.3 DisplayPort™ (DP)

Optionally, the conga-SMX8-Mini can offer a DisplayPort (DP0)[1] via a TI SN65DSI86 DSI to eDP bridge instead of LVDS (assembly option)[2].

Note

1. *Dual-mode DisplayPort (DP++) is not supported (DP0_AUX_SEL is not connected).*
2. *PN 051204 offers a DP instead of LVDS (Table 1).*

5.2 Camera Inteface (MIPI® CSI)

The conga-SMX8-Mini offers a MIPI CSI-2 interface with two lanes (CSI0) by default. Optionally, the conga-SMX8-Mini can offer a MIPI CSI-2 interface with four lanes (CSI1) instead (assembly option). Either interface supports a maximum bitrate of 1.5 Gbps per lane.

5.3 SD/SDIO Card Interface

The conga-SMX8-Mini offers an SD/SDIO card interface. The interface is connected to the second Ultra Secure Digital Host Controller (uSDHC2) of the SoC. The interface is compatible with the SD/SDIO specification 3.0 and supports the following features:

- 200 MHz SDR signaling for up to 100 MBps
- Secure Digital eXtended Capacity (SDXC™) cards
- 1.8V Signaling UHS-I @SDR 104/50/25/12 and DDR50
- 3.3 V Signaling @Default Mode and High Speed Mode

5.4 SPI Interfaces

The conga-SMX8-Mini can offer up to two SPI:

- SPI0[1] is connected to the second Enhanced Configurable SPI (eCSPI2) of the SoC
- SPI1[2] can be connected to the first Quad SPI (QSPI_A) of the SoC instead of the onboard QSPI NOR flash memory (assembly option)

Note

1. *SPI0_CS1# is supported on conga-SMX8-Mini as of hardware revisions B.0. On prior hardware revisions, SPI0_CS1# is not connected.*
2. *eSPI is not supported (ESPI_RESET# and ESPI_ALERT[0:1]# are not connected).*

5.5 I2C Interfaces

The conga-SMX8-Mini offers two I²C interfaces with support for data rates up to 320 kbps:

- I2C_PM[1] is connected to I2C2 of the SoC
- I2C_GP[2] is connected to I2C3 of the SoC

Note

1. *I2C_PM is shared with the LVDS/DSI_I2C. All devices on this bus must have a unique address.*
2. *I2C_GP is shared with CSI_I2C. All devices on this bus must have a unique address.*

5.6 Audio Interfaces (I2S)

The conga-SMX8-Mini offers two I²S interfaces:

- I2S0 connected to the third Synchronous Audio Interface (SAI3) of the SoC
- I2S2 connected to the fifth Synchronous Audio Interface (SAI5) of the SoC

5.7 Serial Ports

The conga-SMX8-Mini offers three asynchronous serial ports by default with support for programmable baud rates of up to 4 Mbps:

- SER0 is a four wire port (two data lines and two handshake lines) connected to UART3 of the SoC
- SER1 is a two wire port (data only) connected to UART4 of the SoC
- SER2 is a four wire port (two data lines and two handshake lines) connected to UART1 of the SoC

Optionally, the conga-SMX8-Mini can offer an onboard M4 console interface instead of SER1 (assembly option). For more information, see section 6.6.2 “M4 Console”.

Optionally, the conga-SMX8-Mini can offer an onboard Wi-Fi and Bluetooth combo module instead of SER2 (assembly option). For more information, see section 6.4 “Wi-Fi and Bluetooth”.

5.8 USB Ports

The conga-SMX8-Mini offers five USB 2.0 ports by default:

- USB0[1] supports OTG and is connected to USB1 of the SoC
- USB1, USB2, USB3 and USB4 are provided via an onboard hub connected to USB2 of the SoC

Optionally, the conga-SMX8-Mini can offer an onboard Wi-Fi and Bluetooth combo module instead of USB4 (assembly option). For more information, see section 6.4 "Wi-Fi and Bluetooth".

Note

1. *USB0 is used for the Serial Downloader mode. Fore more information, see FORCE_RECOV# description in section 5.12 "Boot Select".*

5.9 PCI Express™

The conga-SMX8-Mini offers one PCI Express x1 Gen 2 interface (PCIE_A) with up to 5 GTps.

Note

1. *PCIE_B_RST# and PCIE_C_RST# are connected to ground on the module.*
2. *PCIE_A_CKREQ# is connected to a pull down resistor to comply with SMARC Specification 2.1.*
3. *PCIE_A_CKREQ# is not connected on conga-SMX8-Mini revisions prior to B.0.*
4. *PCI Express link L1 sub-states are not supported (PCIE_A_REFCK± is always running).*

5.10 Ethernet

The conga-SMX8-Mini offers one Gigabit Ethernet interface (GBE0) via a TI DP83867 PHY with support for IEEE 1588v2.

The PHY is connected to the GbE controller of the SoC. The GBE0_TRIGGER pin is connected to the 1588_OUT signal of the SoC by default. Optionally, the GBE0_TRIGGER pin can be connected to the 1588_IN signal of the SoC instead (assembly option).

Note

conga-SMX8-Mini revisions prior to B.0 offer GBE0 via an Atheros AR8031 PHY with support for IEEE 1588v2.

5.11 GPIO

The conga-SMX8-Mini offers fourteen GPIOs (GPIO[0:13]) as defined in the SMARC 2.1 specification. Additionally, the following pins can also be used as GPIOs:

- BOOT_SEL[0:2]#
- BATLOW#
- TEST#
- CHARGING#
- CHARGER_PRSNT#

Note

1. *conga-SMX8-Mini revisions prior to B.0 offer twelve GPIOs (GPIO[0:11)].*

2. *The signals are inputs and have pull-down resistors enabled in the SoC until the U-Boot/OS is initialized.*

5.12 Boot Select

BOOT_SEL[0:2]#

The conga-SMX8-Mini does not support boot source selection via input straps (BOOT_SEL[0:2]#) because it uses the Boot From Fuses mode. The eFUSES are preset by congatec to load the bootloader (U-Boot) from the onboard QSPI NOR flash memory (see section 6.3 "QSPI NOR Flash Memory"). The OS boot device is defined via the U-Boot environment variables. For more information, refer to the conga-SMX8-Mini online software documentation at https://wiki.congatec.com.

FORCE_RECOV#

Low on the FORCE_RECOV# pin enables the Serial Downloader mode. The program image can be downloaded over the USB0 port (see section 5.8 "USB Ports").

5.13 Power Control

The module only operates with 5 V input voltage. The power-up sequence is described below:

1. The carrier board provides the 5 V input voltage (VDD_IN) to the module.
2. If VIN_PWR_BAD# is not driven low, the module enables its power circuits.
3. Depending on the carrier board design and configuration, the module either a) starts the power-up sequence after the first VIN power on or b) waits for a power button event (PWRBTN#) before it starts the power-up sequence.
4. The module enables the carrier board power by asserting CARRIER_PWR_ON and CARRIER_STBY#.
5. If RESET_IN# is not driven low, 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 A53 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 or reboot. The booting process can be postponed by driving RESET_IN# low during power on sequence.

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. RESET_OUT# can also be controlled by software via SoC GPO.

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 up or shut down the system from the SNVS mode.

Power Supply Implementation Guidelines

The operational power source for the conga-SMX8-Mini is 5 V. 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-SMX8-Mini application:

- We have noticed that on some occasions, problems occur when using a 5 V 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. For more information, see the "Power Supply Design Guide for Desktop Platform Form Factors" document at www.intel.com.

Inrush and Maximum Current Peaks on VDD_IN

The maximum peak-current on the conga-SMX8-Mini VDD_IN (5 V) power rail can be as high as 3.44 A for a maximum of 114.05 µs. You should therefore ensure the power supply and decoupling capacitors provide enough power to drive the module.

Note

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

6 Onboard Interfaces and Devices

6.1 DRAM

The conga-SMX8-Mini offers onboard 32 bit LPDDR4-3000 SDRAM. The memory size of each conga-SMX8-Mini variant is listed in section 1.2.1 "Options Information".

6.2 eMMC

The conga-SMX8-Mini offers an onboard eMMC 5.1 HS400 storage device with up to 128 GB (16 GB assembled 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

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

6.3 QSPI NOR Flash Memory

The conga-SMX8-Mini offers an onboard Quad SPI (QSPI) NOR flash memory chip with up to 256 Mbit (64 Mbit assembled by default). The QSPI NOR flash memory chip is connected to the first QSPI (QSPI_A) of the SoC. Optionally, the QSPI_A signals can be connected to SPI1 instead to provide an additional SPI. For more information, see section 5.4 "SPI Interfaces".

Note

conga-SMX8-Mini revisions prior to B.0 offer an onboard QSPI NOR flash memory chip with up to 128 Mbit (64 Mbit assembled by default).

6.4 Wi-Fi and Bluetooth

Optionally, the conga-SMX8-Mini can offer Wi-Fi and Bluetooth connectivity via one of the two modules (assembly option)[1]:

- AzureWave AW-CM276NF 802.11 a/b/g/n/ac 2x2+BT5.0
- AzureWave AW-NM191NF 802.11 b/g/n 1x1

The module can be connected via different interfaces[2]:

- SDIO (recommended; connected to SD1 of the SoC)
- PCI Express (instead of PCIE_A on the SMARC connector; connected to PCIE of the SoC)
- USB (instead of USB4 on the SMARC connector; connected to USB2 of the SoC via a USB hub)
- Serial Port (instead of SER2 on the SMARC connector; connected to UART1 of the SoC)

Note

1. *conga-SMX8-Mini revisions prior to B.0 offer an onboard H&D Wireless SPB228 M.2 1216 module as an assembly option.*
2. *The interface becomes unavailable for other devices. Therefore, congatec recommends the dedicated SDIO interface.*

6.5 RTC

The conga-SMX8-Mini offers the discrete onboard real time clock (RTC) Micro Crystal RV-4162-C7 connected to I2C4 of the SoC.

Note

conga-SMX8-Mini revisions prior to B.0 offer onboard ST M41T62 RTC. The Micro Crystal RV-4162-C7 RTC is software compatible.

6.6 Console and Debug Interfaces

6.6.1 A53 Console

The conga-SMX8-Mini offers a Cortex®-A53 console interface on connector X2. The connector pinout is described in the table below:

Table 9 A53 and M4 Console Connector (X2) Pinout Description

Pin	SoC Signal	Description
1	UART4_TXD	M4 Console (assembly option): Transmit signal via ISL3243E RS-232 Transmitter/Receiver connected to UART4_TXD of the SoC
2	+VIN	SMARC VDD_IN (+5V)
3	GND	Ground
4	UART2_TXD	A53 Console: Transmit signal via ISL3243E RS-232 Transmitter/Receiver connected to UART2_TXD of the SoC
5	UART2_RXD	A53 Console: Receive signal via ISL3243E RS-232 Transmitter/Receiver connected to UART2_RXD of the SoC
6	UART4_RXD	M4 Console (assembly option): Receive signal via ISL3243E RS-232 Transmitter/Receiver connected to UART4_RXD of the SoC

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

6.6.2 M4 Console

Optionally, the conga-SMX8-Mini can offer a Cortex®-M4 console interface on connector X2 instead of the serial port SER1 (assembly option). The connector pinout is described in Table 9 above.

6.6.3 JTAG Debug

Optionally, the conga-SMX8-Mini can offer an onboard JTAG debug interface via a 10 pin PicoBlade connector (X3) (assembly option). The connector pinout is described in the table below:

Table 10 JTAG Debug Connector (X3) Pinout Description

Pin	SoC Signal	Description
1	JTAG_VREF	+1.8V
2	JTAG_TMS	Test mode select
3	GND	Ground
4	JTAG_TCK	Test clock input
5	GND	Ground
6	JTAG_TDO	Test data output
7	JTAG_MOD	Should not be used
8	JTAG_TDI	Test data input
9	NC	Not Connected
10	POR_B	System Reset (JTAG_SRST#)

Connector Type

X3: Molex PicoBlade 0532611071 (10 Circuits, 1.25mm Pitch, Right-Angle, Friction Lock)

Mates with Molex PicoBlade Cable Assembly Series 15134 with 10 Circuits

7 Signal Descriptions and Pinout Tables

Click on the screenshot below to directly download the conga-SMX8-Mini pinout as an Excel file:

X1A + X1B - SX8M SMARC Edge Connection						
SX8M / conga-SMX8-Mini Interface	i.MX8MM Ball Name	i.MX8MM BGA486 Ball	SMARC Pin Name	SMARC Pin	Remark	alt. Function
SMARC Management Pins	SD1_STROBE	R24	SMB_ALERT_1V8#	P1		
SMARC CSI1 I2C Support	I2C3_SCL	E10	CSI1_TX+ / I2C_CAM1_CK	S1	CSI1 option is not populated by default	
GND			GND	P2		
SMARC CSI1 I2C Support	I2C3_SDA	F10	CSI1_TX- / I2C_CAM1_DAT	S2	CSI1 option is not populated by default	
SMARC CSI1 MIPI-CSI 4ch	MIPI_CSI_CLK_P	B16	CSI1_CK+	P3	CSI1 option is not populated by default	
GND			GND	S3		
SMARC CSI1 MIPI-CSI 4ch	MIPI_CSI_CLK_N	A16	CSI1_CK-	P4	CSI1 option is not populated by default	
n.c. - reserved			RSVD	S4		
n.c. - not supported			GBE1_SDP	P5		
SMARC CSI0 I2C Support	I2C3_SCL	E10	CSI0_TX+ / I2C_CAM0_CK	S5		
SMARC Gigabit Ethernet 0			GBE0_SDP	P6	Option, n.c. by default	
SMARC CSI Master clock output	GPIO1_IO14	AC9	CAM_MCK	S6		
SMARC CSI1 MIPI-CSI 4ch	MIPI_CSI_D0_P	B14	CSI1_RX0+	P7	CSI1 option is not populated by default	
SMARC CSI0 I2C Support	I2C3_SDA	F10	CSI0_TX- / I2C_CAM0_DAT	S7		
SMARC CSI1 MIPI-CSI 4ch	MIPI_CSI_D0_N	A14	CSI1_RX0-	P8	CSI1 option is not populated by default	
SMARC CSI0 MIPI-CSI	MIPI_CSI_CLK_P	B16	CSI0_CK+	S8		

Alternatively, you can find the conga-SMX8-Mini pinout by selecting it from the drop-down list at:

https://git.congatec.com/arm-nxp/imx8-family/doc/cgtimx8_pinlist/tree/master

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

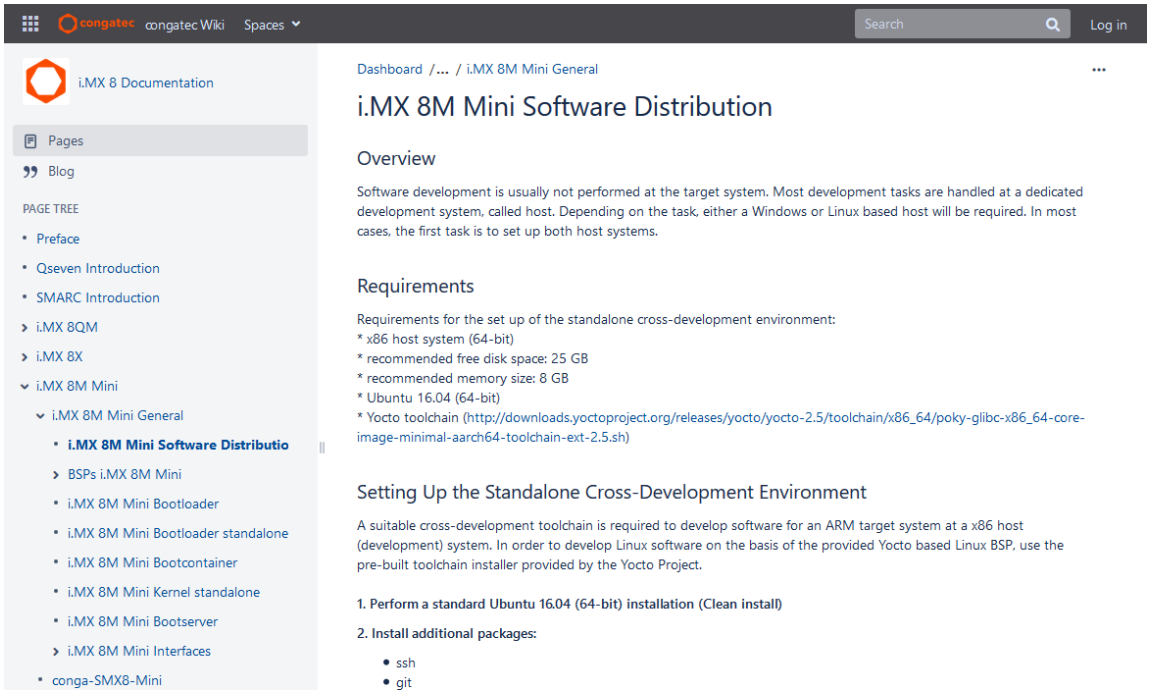
https://sget.org

The SoC signals are described in the i.MX 8M Mini Applications Processor Reference Manual publicly available at:

https://www.nxp.com

8 Software Documentation

Click on the screenshot below to open the conga-SMX8-Mini software documentation in your browser:



Alternatively, you can find the conga-SMX8-Mini software documentation by selecting it from the navigation menu at:

https://wiki.congatec.com