

Hardware Development User Guide

For TRUX Board

TRUX-iMX8MMini-Q01



TRUX-iMX8M Mini-Q01

Rev 1.0

Status: Initial Release

(coming soon)



Contents

Revision History	4
Acronyms and Abbreviations	5
1. Introduction	6
1.1 Purpose	6
1.2 Overview	6
1.3 Specifications	6
2. Block Diagram	8
3. Processor Overview	9
3.1 Part Number Nomenclature	9
3.2 Specifications of i.MX8M Mini Quad processor.....	9
4. SoM Components.....	11
4.1 LPDDR4.....	11
4.2 eMMC Flash	11
4.3 PMIC.....	11
4.4 Audio Codec	11
4.5 Crypto Authentication.....	11
5. Board to Board Connector	12
5.1 B2B J1 Pin Function List.....	12
5.2 B2B J2 Pin Function List.....	15
5.3 B2B J3 Pin Function List.....	18
6. Boot Mode Configuration	21
7. Connectivity	22
7.1 10/100/1000 Mbps Ethernet PHY.....	22
7.2 Ethernet Controller	22
7.3 Wi-Fi & BT & SD/SDIO	23
8. Peripheral Description	24
8.1 UART Interface	24
8.2 SD Interface.....	24
8.3 Display Interface	24
8.4 MIPI CSI Interface.....	24

8.5 I2C Interface.....	24
8.6 PWM Interface.....	24
8.7 GPIO Interface.....	25
8.8 USB 2.0	25
8.9 PCI Express (Gen 2.0)	25
8.10 QSPI.....	25
8.11 ECSPI Enhanced Configurable SPI	25
9. Electrical Characteristics	26
9.1 Power Requirement.....	26
9.2 Power Signal.....	26
9.3 Reset	26
10. Mechanical Dimensions	27
10.1 TRUX-iMX8MMini-Q01 SoM Dimensions	27
10.2 Carrier Board Mounting.....	27
10.3 Standoff and Screw	27
10.4 Thermal Management	27

Revision History

Revision	Date	Notes
1.0	November 30th 2022	Initial Release

Acronyms and Abbreviations

Term	Meaning
I2S	Inter IC Sound
GPIO	General Purpose Input Output
B2B	Board to Board
LPDDR	Low Power Double Data Rate
eMMC	Embedded Multimedia Card
SD	Secure Digital
HDMI	High Definition Multimedia Interface
USB	Universal Serial Bus
PCI	Peripheral Component Interconnect
MIPI	Mobile Industry Processor Interface
DSI	Display Serial Interface
CSI	Camera Serial Interface
I2C	Inter Integrated Circuit
ECSPI	Enhanced Configurable Serial Peripheral Interface
JTAG	Joint Test Action Group
UART	Universal Asynchronous Receiver Transmitter
CAN	Controller Area Network
PMIC	Power Management Integrated Circuit
SNR	Signal to Noise Ratio
ADC	Analog to Digital Converter
DAC	Digital to Analog Converter
SPDIF	Sony / Philips Digital Interface
SAI	Switch Abstraction Interface
CRC	Cyclic Redundancy Check
RGMII	Reduced Gigabit Media Independent Interface
TCP	Transmission Control Protocol
UDP	User Datagram Protocol
ICMP	Internet Control Message Protocol
COL	Computer Oriented Language
PWM	Pulse Width Modulation
FIFO	First In First Out
OTG	On The Go
RDC	Resource Domain Controller
TZ	Trust Zone
OCRAM	On-chip RAM
HAB	High Assurance Boot
CAAM	Cryptographic acceleration and assurance
SNVS	Secure non-volatile storage
RTC	Real-time clock
SJC	Secure JTAG controller
ENET	Ethernet

1. Introduction

1.1 Purpose

This document is the hardware user manual for TRUX-iMX8MMini-Q01 System on Module. The SOM is designed using NXP's i.MX8M Mini application processor. The user manual describes detail information about SOM & its usage.

1.2 Overview

The TRUX-iMX8MMini-Q01 CPU module is an NXP i.MX8M Mini Quad processor implementing quad Arm Cortex-A53 core based system on module operating up to 1.6GHz speed and Cortex-M4 core processor for low power processing with Linux OS. It is cost effective and power efficient. It offers a wide range of interfaces such as GPIOs, SAI, SPI, I2C, UART buses, high speed USB 3.0 interfaces, SD-card, camera & display interface with industry standard.

The SOM is compact in size and integrated with on-board PMIC, 16GB EMMC Flash, 4GB LPDDR4, Audio codec and WIFI / BT well suited for general embedded, Industrial control, consumer and IoT applications. TRUX-iMX8MMini-Q01 is an extreme performance, low-power SoM that provides 4K industry-leading video, voice and audio processing capabilities.

1.3 Specifications

Features:

- CPU: i.MX8M Mini: Cortex-A53 up to 1.6GHz and Cortex-M4
- PMIC: ROHM BD71847AMWV-E2

Memory:

- LPDDR4 (1 - 4GB)
- eMMC (8 – 32 GB)

External Memory:

- SD Card (up to 32GB)

Audio Codec, Stereo:

- Resolution: 24 bit
- Conversion Rate: 96KHz
- SNR: 90dB ADC / 100dB DAC

Power Supply:

- 3.5V to 5V

OS support:

- Yocto Dunfell (Kernel v5.4.142)

-
- Android - Android 11.0.0_1.0.0 (kernel 5.4.47)

Security:

- Secure OS with Hardware Crypto Authentication chip.

Form factor:

- 55.1 mm x 30.2 mm

Supported temperature:

- 0°C to +70°C Commercial
- -40°C to +85°C Industrial

Peripherals:

- LPDDR4 x1 (32bit LPDDR4-3200)
- eMMC x1 (8 bits)
- SD x1 (4bit)
- Ethernet x1 (RGMII with IEEE 1588 STD)
- USB 2.0 (OTG) x2
- PCI Express x1 (Gen 2.0)
- MIPI DSI x1 (lane4)
- MIPI CSI x1 (lane4)
- I2C x4
- SPI x3
- SAI x6
- JTAG x1
- UART x4
- GPIOs
- Boot Mode Signals
- Digital Audio serial interface: I2S (SAI) x4, S/PDIF x1

2. Block Diagram

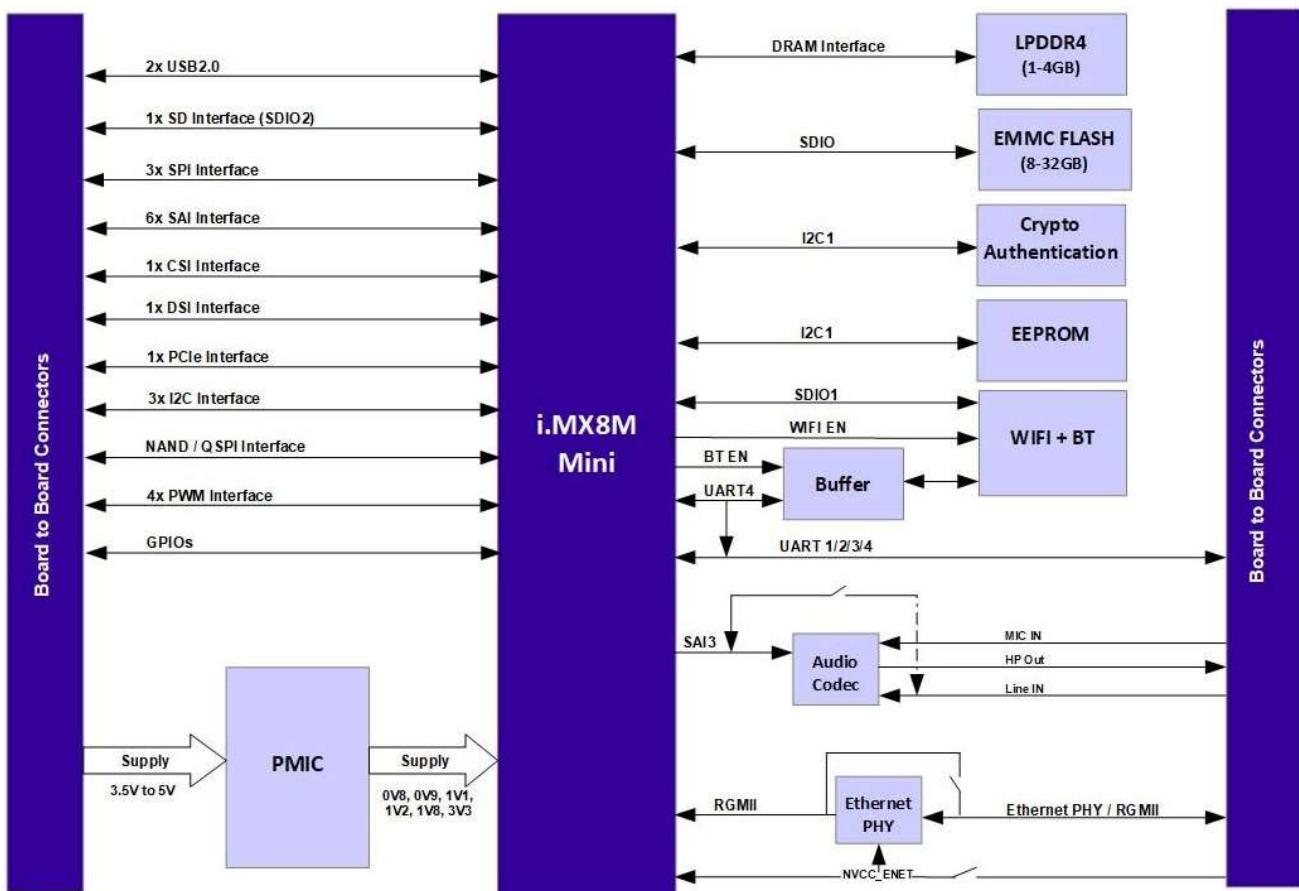


Figure1: Block Diagram of TRUX-iMX8MMini-Q01 SOM

3. Processor Overview

3.1 Part Number Nomenclature

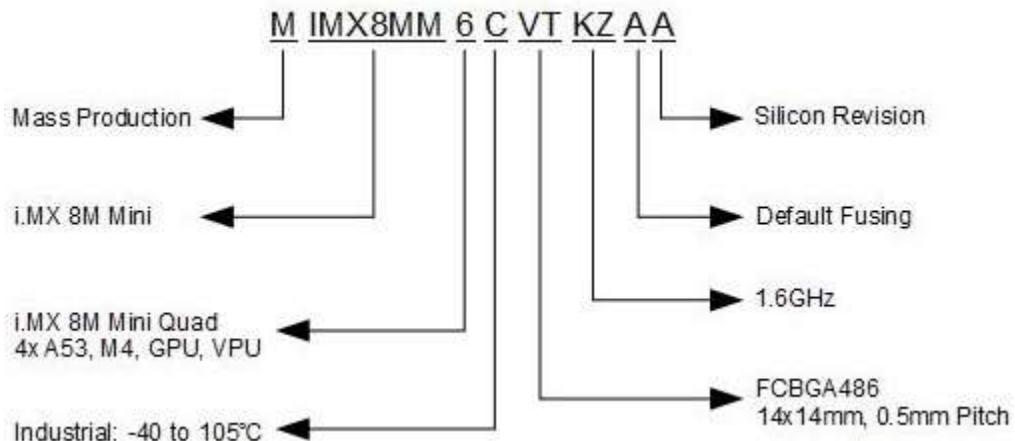


Figure2: Part number description of i.MX8M Mini Processor

3.2 Specifications of i.MX8M Mini Quad processor

The i.MX 8M Mini Media Applications Processor is built to achieve both high performance and low power consumption and relies on a powerful fully coherent core complex based on a quad Cortex-A53 cluster with video and graphics accelerators.

The i.MX 8M Family provides additional computing resources and peripherals:

- Advanced security modules for secure boot, cipher acceleration and DRM support
- General purpose Cortex-M4 processor for low power processing
- A wide range of audio interfaces including I2S, AC97, TDM and S/PDIF
- Large set of peripherals that are commonly used in consumer/industrial markets including USB 2.0, PCIe and Ethernet
 - **Application Processor:** 4x Cortex - A53 core platforms up to 1.8 GHz per core, 1x Cortex – M4 core up to 400MHz
 - **Graphic Processor:** 3D GPU (1x shader, OpenGL ES 2.0), 2D GPU
 - **Video Playback:**
 - 1080p60 VP9 Profile 0, 2 (10-bit) decoder, HEVC/H.265 decoder, AVC/H.264 Baseline, Main, High decoder, VP8 decoder

- 1080p60 AVC/H.264 encoder, VP8 encoder
- Display: 1x MIPI DSI (4-lane) with PHY
- Audio: 5x SAI (12Tx + 16Rx external I2S lanes), 8ch PDM input Dual Camera Interfaces: MIPI-CSI (4-lanes each)
- USB: 2x USB 2.0 OTG controllers with integrated PHY
- PCIe: 1x PCIe 2.0 (1-lane) with L1 low power substates
- Ethernet: 1x Gigabit Ethernet (MAC) with AVB and IEEE 1588, Energy Efficient Ethernet (EEE) for low power
- OS: Linux®, Android™
- **Security**
 - RDC – Resource Domain Controller: Supports 4 domains and up to 8 regions
 - Arm TrustZone including the TZ architecture: ARM Cortex-A53 MPCore TrustZone support
 - On-chip RAM (OCRAM) secure region protection using OCRAM controller
 - High Assurance Boot (HAB)
 - Cryptographic Acceleration and Assurance Module (CAAM) o Support Widevine and PlayReady content protection
 - Public Key Cryptography (PKHA) with RSA and Elliptic Curve (ECC) algorithms
 - Real-time integrity checker (RTIC)
 - DRM support for RSA, AES, 3DES, DES
 - Side channel attack resistance
 - True random number generation (RNG)
 - Manufacturing protection support
 - Secure Non-Volatile Storage (SNVS), including o Secure Real Time Clock (RTC)
 - Secure JTAG Controller (SJC)
- **Power Management**
 - Temperature sensor with programmable trip points
 - Flexible power domain partitioning with internal power switches to support efficient power management

4. SoM Components

4.1 LPDDR4

TRUX-iMX8MMini-Q01 SOM supports 1GB - 4GB LPDDR4 RAM (32bit LPDDR4-3200) memory. To support this, it uses single LPDDR4 IC. This chip operates at 1.1V voltage level.

4.2 eMMC Flash

The TRUX-iMX8MMini-Q01 SOM supports 8GB- 32 GB eMMC Flash as boot device. This is connected to i.MX8M Mini CPU and operates at 1.8 Voltage level.

4.3 PMIC

TRUX-iMX8MMini-Q01 SOM supports BD71847AMWV-E2 PMIC for on-SOM power management. The BD71847AMWV-E2 is a Power Management Integrated Circuit (PMIC) designed specifically for i.MX8M Mini application processors.

The BD71847AMWV-E2 PMIC provides all required power to i.MX8M Mini CPU and all on SOM peripherals. 3.5 -5V power input from B2B connector come to PMIC as an input & PMIC generates all other required powers internally on SOM itself.

4.4 Audio Codec

TRUX-iMX8MMini-Q01 SOM provides high performance audio as it contains ultra –low power stereo CODEC (WM8904), optimized for portable audio applications.

- 3.0mW quiescent power consumption for DAC to headphone playback
- DAC SNR 96dB typical, THD -86dB typical
- ADC SNR 91dB typical, THD -80dB typical
- 2.4mW quiescent power consumption for analogue bypass playback
- Integrated FLL provides all necessary clocks
 - Self-clocking modes allow processor to sleep
 - All standard sample rates from 8kHz to 96kHz
- Stereo digital microphone input
- 3 single ended inputs per stereo channel
- 1 fully differential mic / line input per stereo channel
- Ground-referenced headphone driver
- Ground-referenced line outputs

4.5 Crypto Authentication

TRUX-iMX8MMini-Q01 SOM has facility to integrate Secure OS with Hardware Crypto Chip. The ATECC608B (default not populated on SOM) is a member of the Microchip CryptoAuthentication™ family of high-security cryptographic devices, which combine world-class, hardware-based key storage with hardware cryptographic accelerators to implement various authentication and encryption protocols. The ATECC608B provides security enhancements.

5. Board to Board Connector

The TRUX-iMX8MMini-Q01 exposes three 90-pin board-to-board connectors. The recommended mating connector is Hirose P/N: **DF40C-90DS-0.4V (51)**.

Below is a list of all i.MX8M Mini pins, configured using the BSP – under ALT0 to ALT6 and alternate ICs which are available on B2B connectors.

5.1 B2B J1 Pin Function List

B2B Connector Pin Number	B2B Connector Pin Name	i.MX8M Mini Alternate Signals	i.MX8 M Alternates	Imx8m Ball Number	Alternate ICs Signals Name	Alternate ICs Pin Number
J1.1	GPIO1_IO00	REF_CLK_32K	ALT5	SOC.AG14	GPIO1_IO00	AP6275S.31
J1.2	ETH_TRX1_P	ENET_TD1	ALT0	SOC.AF26	ETH_TRX1_P	RTL8211FS.5
J1.3	NC					
J1.4	ETH_TRX1_N	ENET_TDO	ALT0	SOC.AG26	ETH_TRX1_N	RTL8211FS.6
J1.5	LED_LINK10_100	ENET_TXC	ALT0	SOC.AG24	LED_LINK10_100	RTL8211FS.35
J1.6	ETH_TRX0_N	ENET_TD2	ALT0	SOC.AG25	ETH_TRX0_N	RTL8211FS.3
J1.7	LED_LINK1000	ENET_RXC	ALT0	SOC.AE26	LED_LINK1000	RTL8211FS.36
J1.8	ETH_TRX0_P	ENET_TD3	ALT0	SOC.AF25	ETH_TRX0_P	RTL8211FS.2
J1.9	LED_ACT	ENET_RX_CTL	ALT0	SOC.AF27	LED_ACT	RTL8211FS.37
J1.10	ETH_TRX2_P	ENET_RDO	ALT0	SOC.AE27	ETH_TRX2_P	RTL8211FS.7
J1.11	NC					
J1.12	ETH_TRX2_N	ENET_RD1	ALT0	SOC.AD27	ETH_TRX2_N	RTL8211FS.8
J1.13	NC					
J1.14	ETH_TRX3_P	ENET_RD2	ALT0	SOC.AD26	ETH_TRX3_P	RTL8211FS.10
J1.15	NVCC_SNVS_1V8			POWER IN		
J1.16	ETH_TRX3_N	ENET_RD3	ALT0	SOC.AC26	ETH_TRX3_N	RTL8211FS.11
J1.17	I2C4_SCL	GPIO5_IO20	ALT5	SOC.D13		
J1.18	GND			GND		
J1.19	I2C4_SDA	GPIO5_IO21	ALT5	SOC.E13		
J1.20	ONOFF_1v8			SOC.A25		
J1.21	GND			GND		
J1.22	PMIC_ON_REQ			SOC.A24		
J1.23	BT_HOST_WAKE					AP6275S.50
J1.24	POR_B			SOC.B24		
J1.25	WIFI_HOST_WAKE					AP6275S.16
J1.26	PMIC_STBY_REQ			SOC.E24		
J1.27	NVCC_3V3			POWER OUT		
J1.28	SD2_RESET_B	GPIO2_IO19	ALT5	SOC.AB26		

J1.29	SD1_DATA7	GPIO2_IO09_1v8	ALT5	SOC.W26		
J1.30	GND			GND		
J1.31	NVCC_ENET			POWER IN		
J1.32	NAND_DATA01	GPIO3_IO07	ALT5	SOC.K24		
J1.33	GND			GND		
J1.34	NAND_CE0_B	GPIO3_IO01	ALT5	SOC.N24		
J1.35	CLKIN1_1v8		ALT5	SOC.H27		
J1.36	NC					
J1.37	CLKIN2_1v8	GPIO3_IO12	ALT5	SOC.J27		
J1.38	NAND_DQS	GPIO3_IO14	ALT5	SOC.R22		
J1.39	NC					
J1.40	NAND_ALE	GPIO3_IO00	ALT5	SOC.N22		
J1.41	ENET_MDIO	GPIO1_IO07	ALT5	SOC.AB27		
J1.42	NC	NC				
J1.43	NC	NC				
J1.44	NC	NC				
J1.45	CLKOUT1_1v8		ALT5	SOC.H26		
J1.46	NAND_DATA03	GPIO3_IO09	ALT5	SOC.N23		
J1.47	CLKOUT2_1v8		ALT5	SOC.J26		
J1.48	NAND_DATA00	GPIO3_IO06	ALT5	SOC.P23		
J1.49	GND			GND		
J1.50	NAND_DATA02	GPIO3_IO08	ALT5	SOC.K23		
J1.51	PCIE1_REF_CLKM			SOC.A21		
J1.52	GND			GND		
J1.53	PCIE1_REF_CLKP			SOC.B21		
J1.54	NC					
J1.55	GND			GND		
J1.56	NC					
J1.57	PCIE1_TXM			SOC.A20		
J1.58	GND			GND		
J1.59	PCIE1_TXP			SOC.B20		
J1.60	PCIE1_RXM			SOC.A19		
J1.61	GND			GND		
J1.62	PCIE1_RXP			SOC.B19		
J1.63	NC					
J1.64	GND			GND		
J1.65	NC					
J1.66	NC					
J1.67	GND			GND		

J1.68	NC				
J1.69	CSI_P1_DP3			SOC.B18	
J1.70	GND			GND	
J1.71	CSI_P1_DN3			SOC.A18	
J1.72	NC				
J1.73	CSI_P1_DP1			SOC.B15	
J1.74	SD2_CD_B	GPIO2_IO12	ALT5	SOC.AA26	
J1.75	CSI_P1_DN1			SOC.A15	
J1.76	GND			GND	
J1.77	CSI_P1_DN2			SOC.A17	
J1.78	SD2_DATA2	GPIO2_IO17	ALT5	SOC.V24	SDIOMUX
J1.79	CSI_P1_DP2			SOC.B17	
J1.80	SD2_DATA1	GPIO2_IO16	ALT5	SOC.AB24	SDIOMUX
J1.81	CSI_P1_DP0			SOC.B14	
J1.82	SD2_CLK	GPIO2_IO13	ALT5	SOC.W23	SDIOMUX
J1.83	CSI_P1_DN0			SOC.A14	
J1.84	SD2_DATA3	GPIO2_IO18	ALT5	SOC.V23	SDIOMUX
J1.85	GND			GND	
J1.86	SD2_DATA0	GPIO2_IO15	ALT5	SOC.AB23	SDIOMUX
J1.87	CSI_P1_CKP			SOC.B16	
J1.88	SD2_CMD	GPIO2_IO14	ALT5	SOC.W24	SDIOMUX
J1.89	CSI_P1_CKN			SOC.A16	
J1.90	NVCC_SD2_1V8_3V3			POWER OUT	

5.2 B2B J2 Pin Function List

B2B Connector Pin Number	B2B Connector Pin Name	i.MX8M Mini Alternate Signals	i.MX8M Alternates	Imx8m Ball Number	Alternate ICs Signals Name	Alternate ICs Pin Number
J2.1	JTAG_TCK		ALT5	SOC.F26		
J2.2	HPLOUT	GPIO4_IO30	ALT5	SOC.AF7	HPLOUT	WM8904.E3
J2.3	JTAG_TMS		ALT5	SOC.F27		
J2.4	HPROUT	GPIO5_IO00	ALT5	SOC.AG6	HPROUT	WM8904.E2
J2.5	JTAG_TRST_B		ALT5	SOC.C27		
J2.6	HPOUTFB	GPIO4_IO28	ALT5	SOC.AG8	HPOUTFB	WM8904.F3
J2.7	JTAG_TDI		ALT5	SOC.E27		
J2.8	LINEIN1_LP	GPIO4_IO29	ALT5	SOC.AG7	LINEIN1_LP	WM8904.A2
J2.9	JTAG_TDO		ALT5	SOC.E26		
J2.10	LINEIN1_RP	GPIO4_IO31	ALT5	SOC.AC6	LINEIN1_RP	WM8904.B2
J2.11	BOOT_MODE1		ALT5	SOC.G27		
J2.12	AGND		ALT5	AUDIO AGND		WM8904.C1
J2.13	BOOT_MODE0		ALT5	SOC.G26		
J2.14	DMIC_CLK	GPIO5_IO01	ALT5	SOC.AF6	DMIC_CLK	WM8904.A3
J2.15	NC					
J2.16	DMIC_DATA	GPIO5_IO02	ALT5	SOC.AD6	DMIC_DATA_1V8	WM8904.B3
J2.17	NC					
J2.18	GND			GND		
J2.19	NC					
J2.20	ECSPI2_MOSI	UART4_TXD	ALT1	SOC.B8		
J2.21	NC					
J2.22	ECSPI2_MISO	UART4_CTS	ALT1	SOC.A8		
J2.23	GND			GND		
J2.24	ECSPI2_SCLK	UART4_RXD	ALT1	SOC.E6		
J2.25	NC					
J2.26	ECSPI2_SS0	UART4 RTS	ALT1	SOC.A6		
J2.27	NC					
J2.28	GPIO1_IO02		ALT0	SOC.AG13		
J2.29	NC					
J2.30	I2C2_SDA	GPIO5_IO17		SOC.D9		
J2.31	NC					
J2.32	I2C2_SCL	GPIO5_IO16	ALT5	SOC.D10		
J2.33	NC					
J2.34	SAI5_RXFS	GPIO3_IO19	ALT5	SOC.AB15		
J2.35	NC					

J2.36	SAI5_RXD0	GPIO3_IO21	ALT5	SOC.AD18		
J2.37	NC					
J2.38	SAI5_RXD2	GPIO3_IO23	ALT5	SOC.AD13		
J2.39	NC					
J2.40	SAI5_RXC	GPIO3_IO20	ALT5	SOC.AC15		
J2.41	NC					
J2.42	SAI5_RXD1	GPIO3_IO22	ALT5	SOC.AC14		
J2.43	NC					
J2.44	SAI5_RXD3	GPIO3_IO24	ALT5	SOC.AC13		
J2.45	NC					
J2.46	SAI5_MCLK	GPIO3_IO25	ALT5	SOC.AD15		
J2.47	GND			GND		
J2.48	SAI2_RXFS	GPIO4_IO21	ALT5	SOC.AC19		
J2.49	NC					
J2.50	SAI2_RXC	GPIO4_IO22	ALT5	SOC.AB22		
J2.51	NC					
J2.52	SAI2_TXFS	GPIO4_IO24	ALT5	SOC.AD23		
J2.53	GND			GND		
J2.54	SAI2_MCLK	GPIO4_IO27	ALT5	SOC.AD19		
J2.55	SAI1_RXFS	GPIO4_IO00	ALT5	SOC.AG16		
J2.56	SAI2_TXC	GPIO4_IO25	ALT5	SOC.AD22		
J2.57	SAI1_RXC	GPIO4_IO01	ALT5	SOC.AF16		
J2.58	SAI2_RXD0	GPIO4_IO23	ALT5	SOC.AC24		
J2.59	SAI1_RXD1	BOOT_CFG01	ALT6	SOC.AF15		
J2.60	SAI2_TXD0	GPIO4_IO26	ALT5	SOC.AC22		
J2.61	SAI1_RXD0	BOOT_CFG00	ALT6	SOC.AG15		
J2.62	SAI1_RXD3	BOOT_CFG03	ALT6	SOC.AF17		
J2.63	SAI1_RXD2	BOOT_CFG02	ALT6	SOC.AG17		
J2.64	SAI1_TXFS	GPIO4_IO10	ALT5	SOC.AB19		
J2.65	SAI1_RXD4	BOOT_CFG04	ALT6	SOC.AG18		
J2.66	SAI1_RXD6	BOOT_CFG06	ALT6	SOC.AG19		
J2.67	SAI1_TXD1	BOOT_CFG09	ALT6	SOC.AF20		
J2.68	SAI1_RXD7	BOOT_CFG07	ALT6	SOC.AF19		
J2.69	SAI1_RXD5	BOOT_CFG05	ALT6	SOC.AF18		
J2.70	SAI1_TXD0	BOOT_CFG08	ALT6	SOC.AG20		
J2.71	SAI1_TXD5	BOOT_CFG13	ALT6	SOC.AF22		
J2.72	SAI1_TXC	GPIO4_IO11	ALT5	SOC.AC18		
J2.73	SAI1_TXD3	BOOT_CFG11	ALT6	SOC.AF21		
J2.74	SAI1_TXD4	BOOT_CFG12	ALT6	SOC.AG22		

J2.75	GND			GND		
J2.76	SAI1_TXD7	BOOT_CFG15	ALT6	SOC.AF23		
J2.77	ECSPI1_SCLK	GPIO5_IO06	ALT5	SOC.D6		
J2.78	SAI1_TXD2	BOOT_CFG10	ALT6	SOC.AG21		
J2.79	ECSPI1_SS0	GPIO5_IO09	ALT5	SOC.B6		
J2.80	SAI1_TXD6	BOOT_CFG14	ALT6	SOC.AG23		
J2.81	ECSPI1_MISO	GPIO5_IO08	ALT5	SOC.A7		
J2.82	SAI1_MCLK	GPIO4_IO20	ALT5	SOC.AB18		
J2.83	ECSPI1_MOSI	GPIO5_IO07	ALT5	SOC.B7		
J2.84	GND			GND		
J2.85	UART2_RXD	GPIO5_IO24	ALT5	SOC.F15		
J2.86	UART2_TXD	GPIO5_IO25	ALT5	SOC.E15		
J2.87	UART3_RXD	GPIO5_IO26	ALT5	SOC.E18		
J2.88	UART1_RXD	GPIO5_IO22	ALT5	SOC.E14		
J2.89	UART3_TXD	GPIO5_IO27	ALT5	SOC.D18		
J2.90	UART1_TXD	GPIO5_IO23	ALT5	SOC.F13		

5.3 B2B J3 Pin Function List

B2B Connector Pin Number	B2B Connector Pin Name	i.MX8M Mini Alternate Signals	i.MX8M Alternates	Imx8m Ball Number	Alternate ICs Signals Name	Alternate ICs Pin Number
J3.1	UART4_TXD	GPIO5_IO29		SOC.B8		AP6275S.41
J3.2	GND					
J3.3	UART4_RXD	GPIO5_IO28		SOC.E6		AP6275S.40
J3.4	DSI_DP0			SOC.B9		
J3.5	NC					
J3.6	DSI_DN0			SOC.A9		
J3.7	NC					
J3.8	DSI_DP1			SOC.B10		
J3.9	GND			GND		
J3.10	DSI_DN1			SOC.A10		
J3.11	NC					
J3.12	DSI_DP3			SOC.B13		
J3.13	NC					
J3.14	DSI_DN3			SOC.A13		
J3.15	GND			GND		
J3.16	GND					
J3.17	NC					
J3.18	USB2_VBUS			SOC.F23		
J3.19	NC					
J3.20	SPDIF_RX	GPIO5_IO04		SOC.AG9		
J3.21	GND			GND		
J3.22	USB2_OTG_ID	GPIO1_IO11		SOC.AC10		
J3.23	DSI_DP2			SOC.B12		
J3.24	SPDIF_EXT_CLK	GPIO5_IO05		SOC.AF8		
J3.25	DSI_DN2			SOC.A12		
J3.26	GND			GND		
J3.27	GND			GND		
J3.28	SPDIF_TX	GPIO5_IO03	ALT5	SOC.AF9		
J3.29	DSI_CKN			SOC.A11		
J3.30	USB2_OTG_OC	GPIO1_IO15	ALT0	SOC.AB9		
J3.31	DSI_CKP			SOC.B11		
J3.32	USB1_OTG_OC	GPIO1_IO13	ALT5	SOC.AD9		
J3.33	GND			GND		
J3.34	I2C3_SDA	GPIO5_IO19		SOC.F10		
J3.35	NC					

J3.36	USB2_ID			SOC.D23		
J3.37	NC					
J3.38	I2C3_SCL	GPIO5_IO18	ALT0	SOC.E10		
J3.39	GND			GND		
J3.40	USB2_OTG_PWR	GPIO1_IO14	ALT0	SOC.AC9		
J3.41	NC					
J3.42	USB1_OTG_PWR	GPIO1_IO12	ALT5	SOC.AB10		
J3.43	NC					
J3.44	USB1_OTG_ID	GPIO1_IO10		SOC.AD10		
J3.45	GND			GND		
J3.46	USDHC1_VSELECT	GPIO1_IO03	ALT5	SOC.AF13		
J3.47	USB2_DP			SOC.B23		
J3.48	USB1_ID		ALT0	SOC.D22		
J3.49	USB2_DN			SOC.A23		
J3.50	USDHC1_CD	GPIO1_IO06	ALT0	SOC.AG11		
J3.51	GND			GND		
J3.52	USDHC2_RESET	GPIO1_IO08	ALT0	SOC.AG10		
J3.53	NC					
J3.54	PMIC_READY	GPIO1_IO05	ALT0	SOC.AF12		
J3.55	NC					
J3.56	CCM_EXT_CLK2	GPIO1_IO01		SOC.AF14		
J3.57	GND			GND		
J3.58	USB1_VBUS		ALT0	SOC.F22		
J3.59	NC					
J3.60	GND		ALT0			
J3.61	NC					
J3.62	NC		ALT0			
J3.63	GND			GND		
J3.64	NC					
J3.65	USB1_DP			SOC.B22		
J3.66	GND					
J3.67	USB1_DN			SOC.A22		
J3.68	NC					
J3.69	NC					
J3.70	NC					
J3.71	VBAT			POWER IN		
J3.72	NC					
J3.73	VBAT			POWER IN		
J3.74	NC					

J3.75	VBAT		POWER IN		
J3.76	NC				
J3.77	VBAT		POWER IN		
J3.78	NC				
J3.79	VBAT		POWER IN		
J3.80	NC				
J3.81	VBAT		POWER IN		
J3.82	NC				
J3.83	VBAT		POWER IN		
J3.84	NC				
J3.85	VBAT		POWER IN		
J3.86	NC				
J3.87	VBAT		POWER IN		
J3.88	NC				
J3.89	VBAT		POWER IN		
J3.90	NC				

6. Boot Mode Configuration

The chip will always boot from the A53 core first, the M4 core will be held in reset during the A53 boot and won't run until it is enabled by the A53 core. The image for the M4 core will be loaded into memory and authenticated by the A53 core. Resistor setting is used to select the interface for booting.

TRUX-iMX8MMini-Q01 SOM supports two boot mode signals on B2B Connector. **BOOT_MODE** is initialized by sampling the **BOOT_MODE0** and **BOOT_MODE1** inputs on the rising B2B of POR_B. These Boot mode selection signals are connected to B2B connector and desired boot mode must be set from the carrier board as explained in the below table.

Signal	J2 B2B Pin number	I/O	Description
BOOT_MODE0	13	I	Used to set Mode of boot
BOOT_MODE1	11	I	Used to set Mode of boot

Booting Configuration through SD Card / eMMC:

Signal	B2B Pin number	Description
BOOT_CONFIG0	J2.61	All boot configuration pins are MUX GPIOs
BOOT_CONFIG1	J2.59	
BOOT_CONFIG2	J2.63	
BOOT_CONFIG3	J2.62	
BOOT_CONFIG4	J2.65	
BOOT_CONFIG5	J2.69	
BOOT_CONFIG6	J2.66	
BOOT_CONFIG7	J2.68	
BOOT_CONFIG8	J2.70	
BOOT_CONFIG9	J2.67	
BOOT_CONFIG10	J2.78	
BOOT_CONFIG11	J2.73	
BOOT_CONFIG12	J2.74	
BOOT_CONFIG13	J2.71	
BOOT_CONFIG14	J2.80	
BOOT_CONFIG15	J2.76	

7. Connectivity

7.1 10/100/1000 Mbps Ethernet PHY

The TRUX-iMX8MMini-Q01 features Realtek RTL8211FSI Integrated Ethernet PHY. The RTL8211FSI Ethernet transceiver requires only a single 3.3 V power supply.

The RTL8211FSI Ethernet PHY supports IEEE 802.3ab/u/az-2010 standard. The key features include:

- 10BASE-T/100BASE-TX/1000BASE-T IEEE 802.3 compliant
- Supports RGMII with 3.3/2.5/1.8/1.5V signal voltage
- Supports crossover detection & auto-correction
- Supports PCS and auto-negotiation with next page support
- Wake-on-LAN (WoL) to detect magic packet and notify the sleeping system to wake up
- Robust operation over up to 120 meters of CAT5 cable

Signal	B2B connector Pin number	Description
ETH_TRX0_P	J1.8	PHY Lane 0 POS
ETH_TRX0_N	J1.6	PHY Lane 0 NEG
ETH_TRX1_P	J1.2	PHY Lane 1 POS
ETH_TRX1_N	J1.4	PHY Lane 1 NEG
ETH_TRX2_P	J1.10	PHY Lane 2 POS
ETH_TRX2_N	J1.12	PHY Lane 2 NEG
ETH_TRX3_P	J1.14	PHY Lane 3 POS
ETH_TRX3_N	J1.16	PHY Lane 3 NEG
LED_LINK10_100	J1.5	Activity LED, Active High Part of RTL8211FSI Boot Strap - 10K PD on SOM
LED_LINK1000	J1.7	Activity LED, Active High Part of RTL8211FSI Boot Strap - 10K PD on SOM
LED_ACT	J1.9	Activity LED, Active High Part of RTL8211FSI Boot Strap - 10K PD on SOM

7.2 Ethernet Controller

The Ethernet MAC in i.MX8M Mini CPU is designed to support 10/100/1000 Mbps Ethernet/IEEE 802.3 networks. It is connected to B2B connector which works at 3.3V, 2.5V and 1.8V IO voltage level. The module has dedicated hardware to support the IEEE 1588 standard.

Ethernet MAC controller supports IEEE 802.3az standard.

The key features include:

- Implements the full 802.3 specification with preamble/SFD generation, frame padding generation, CRC generation and checking.
- Dynamically configurable to support 10/100-Mbit/s and gigabit operation.
- Seamless interface to commercial Ethernet PHY devices via one of the following:

- 4-bit Media Independent Interface (MII) operating at 2.5/25 MHz
- 4-bit non-standard MII-Lite (MII without the CRS and COL signals) operating at 2.5/25 MHz
- 2-bit Reduced MII (RMII) operating at 50 MHz (double data rate) 4-bit Reduced GMII (RGMII) operating at 125 MHz
- Operates on TCP/IP and UDP/IP and ICMP/IP protocol data or IP header only.

Signal	B2B connector Pin number	Description
ENET_TDO	J1.4	RGMII Interface
ENET_TD1	J1.2	RGMII Interface
ENET_TD2	J1.6	RGMII Interface
ENET_TD3	J1.8	RGMII Interface
ENET_TX_CTL	J1.3	RGMII Interface
ENET_TXC	J1.5	RGMII Interface
ENET_RDO	J1.10	RGMII Interface
ENET_RD1	J1.12	RGMII Interface
ENET_RD2	J1.14	RGMII Interface
ENET_RD3	J1.16	RGMII Interface
ENET_RX_CTL	J1.9	RGMII Interface
ENET_RXC	J1.7	RGMII Interface
ENET_MDC	J1.13	RGMII Interface
ENET_MDIO	J1.11	RGMII Interface
ENET1_1588_EVENT1_IN	J2.32	IEEE1588 Interface
ENET1_1588_EVENT1_OUT	J2.30	IEEE1588 Interface
ENET_PHY_REF_CLK_ROOT	J1.1	IEEE1588 Interface

7.3 Wi-Fi & BT & SD/SDIO

The WiFi/BT (AP6275S) module realizes the necessary PHY/MAC layers to support WLAN applications in conjunction with a host processor over a SDIO interface. The modules also provide a Bluetooth/BLE platform through the UART HCI transport layer. Both WLAN and Bluetooth share the same antenna port.

- IEEE 802.11ax/ac/a/b/g/n 2x2 WiFi with Bluetooth5.0 Combo Sip Module
- Two U.FL2 JACK connector for external antenna (**Part number used on SoM: Hirose; U.FL-R-SMT-1(60)**)
- **Antenna cable connected to module must have 50-Ω impedance**
- Latest Linux and Android drivers supported
- WiFi/BT module broad country certifications with multiple antennas: FCC (USA), IC (Canada), ETSI (Europe), Giteki (Japan), and RCM (AU/NZ)

Bluetooth Interface

Bluetooth interface with UART4 (RXD, TXD, CTS and RTS) controlled using tristate buffer. Will allow isolation from the WiFi/BT module and the use by external circuitry via the TRUX-iMX8MMini-Q01 connector.

WIFI/SD Interface

WiFi and SD interface are provided from i.MX8M Mini CPU. WIFI / BT (SDIO1 interface) connected via buffer and SD card (SDIO2 interface) signals given on B2B connector.

8. Peripheral Description

8.1 UART Interface

TRUX-iMX8MMini-Q01 SOM supports three UART interface on B2B connector in which one is for Debug UART interface and other two are for Data UART interface. i.MX8 CPU's UART1 controller is used for Debug UART interface and UART2 & UART3 controller is used for Data UART interface on B2B connector without hardware flow control.

For UART signal details, refer B2B connector J2 pins 88, 90, 85, 86, 87 & 89.

8.2 SD Interface

TRUX-iMX8MMini-Q01 SOM supports one SD card interface. i.MX8M Mini CPU's uSDHC2 controller is used for SD interface which is fully compliant with SD Memory Card Specifications v3.0 including extended-capacity SDHC cards.

For SD card signal details, refer B2B connector J1 pins 74, 86, 80, 78, 84 & 88.

8.3 Display Interface

TRUX-iMX8MMini-Q01 SOM features one MIPI DSI serial port, operating up to a maximum bit rate of 1.5 Gbps. All four lanes are used for interfacing. This module provides iMX8M's MIPI DSI controller with four-lane MIPI display serial interface.

For MIPI DSI details, refer B2B connector J3 pins 4, 6, 8, 10, 12 & 14

8.4 MIPI CSI Interface

This module provides one four-lane MIPI camera serial interface. It operate up to a maximum bit rate of 1.5 Gbps. All four lanes are used for interfacing. TRUX-iMX8MMini-Q01 uses iMX8M Mini's CSI controller.

Refer B2B connector J1 pins 69, 71, 73, 75, 77, 79, 81, 83, 87 & 89.

8.5 I2C Interface

TRUX-iMX8MMini-Q01 SOM features three I2C interface on B2B connector. i.MX8M Mini CPU's I2C2, I2C3, I2C4 channel is used for General purpose I2C interface which is compatible with the standard NXP I2C bus protocol. It supports standard mode with data transfer rates up to 100kbps and Fast mode with data transfer rates up to 400kbps. I2C1 is connected to PMIC on SOM.

For more details, refer B2B connector J1 pins 17 & 19, J2 pins 30 & 32 and J3 pins 34 & 38.

8.6 PWM Interface

TRUX-iMX8MMini-Q01 SOM features four PWM interfaces on B2B connector. i.MX8M Mini CPU's PWM1, PWM2, PWM3 and PWM4 module is used for PWM interface. The pulse-width modulator (PWM) has a 16-bit counter and is optimized to generate sound from stored sample audio images. It can also generate tones. It uses 16-bit resolution and a 4x16 data FIFO to generate sound.

For more details, refer B2B connector J3 pins 56, 32, 40, 30.

8.7 GPIO Interface

GPIO Interface is used for general purpose input/output to external ICs. Each GPIO module supports up to 32 bits of I/O.

Most of the i.MX8M Mini CPU Pins which are connected to B2B connector can be configured as GPIO. i.MX8M Mini CPU GPIO controller provides dedicated general-purpose pins that can be configured as either inputs or outputs.

8.8 USB 2.0

TRUX-iMX8MMini-Q01 SOM features two High Speed USB 2.0 OTG interfaces (USB1 & USB2) on B2B connector. i.MX8M Mini CPU's USB Controller which has two independent USB On-The-Go (OTG) controller cores are used for USB OTG interface.

For more details, refer B2B J3 connector pins 65, 67 for USB1 interface and pins 47, 49 for USB2 interface.

8.9 PCI Express (Gen 2.0)

TRUX-iMX8MMini-Q01 SOM exposes one, PCI Express GEN 2 single lane interfaces. PCI Express port requires an external 100MHz PCIe compliant reference clock (Refer J1 pin no. 51, 53).

For more details, refer B2B connector J1 pins 57, 59, 60 & 62 for PCIE1.

8.10 QSPI

TRUX-iMX8MMini-Q01 SOM features QSPI interface on B2B connector. i.MX8M Mini CPU's Quad SPI module is used for General purpose SPI interface which is compatible with the standard NXP SPI bus protocol.

For more details, refer B2B connector J1 pins 32, 34, 38, 40, 46, 48, 50.

8.11 ECSPI Enhanced Configurable SPI

The Enhanced Configurable Serial Peripheral Interface (ECSPI) is a full-duplex, synchronous, four-wire serial communication block with full-duplex enhanced Synchronous Serial Interface and data rate up to 52 Mbit/s. For more details, refer B2B connector J2. For SPI connections, refer connector J2 pins 77, 79, 81, 83.

9. Electrical Characteristics

9.1 Power Requirement

Power Signal	Min (V)	Typical (V)	Max (V)
VBAT 3.5V to 5V	3.5	3.7	5

9.2 Power Signal

TRUX-iMX8MMini-Q01 SOM works with 3.5V – 5V power input (VBAT) from B2B connector and generates all other required powers using PMIC internally on SOM itself. SOM uses VBAT power input from J3 B2B connector to PMIC and then generates various power rails for i.MX8M Mini CPU.

Signal	J3 B2B connector Pin number	I/O	Description
VBAT	71, 73, 75, 77, 79, 81, 83, 85, 87, 89	I	Input to SOM

9.3 Reset

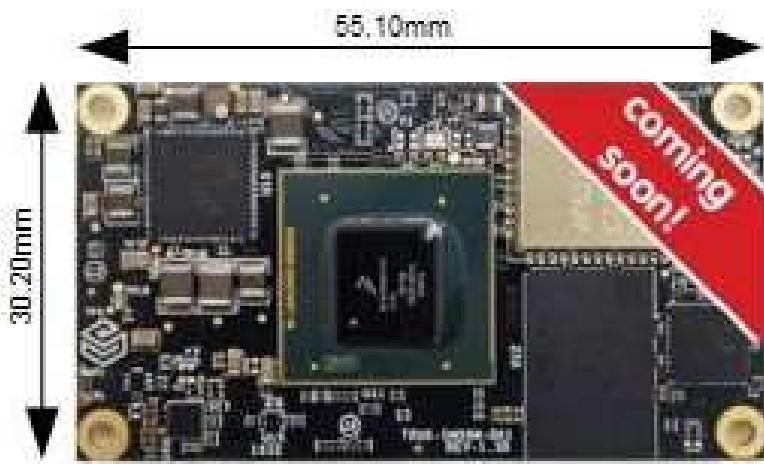
TRUX-iMX8MMini-Q01 SOM features reset signals from carrier board by using push button switch. These signals are connected from J1 B2B connector to iMX8M CPU's pins. This allows resetting the SOM through push button on carrier board.

Signal	B2B connector Pin number
POR_B	J1.24
ONOFF	J1.20
PMIC_STBY_REQ	J1.26
PMIC_ON_REQ	J1.22

10. Mechanical Dimensions

10.1 TRUX-iMX8MMini-Q01 SoM Dimensions

TRUX-iMX8MMini-Q01 SOM has 55.1mm x 30.2mm x 5.00mm (Carrier PCB to highest component on SOM) size as shown below:



10.2 Carrier Board Mounting

TRUX-iMX8MMini-Q01 SOM has four mounting holes (M2) for mounting it to the carrier board which are plated holes and connected to GND.

90-pin board-to-board connectors **Hirose P/N: DF40C-90DP-0.4V(51)** are different from mating carrier board 90-pin connectors.

10.3 Standoff and Screw

For mounting in harsh vibration environments can use the following standoff:

Standoff: **Wurth elektronik; 9774015243R**

Screw: **MiSUMI; CBSTSE2-3**

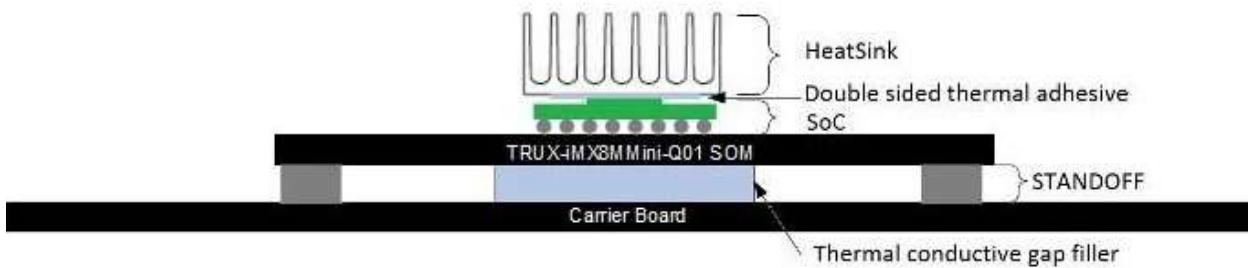
NOTE: The M2 screws head diameter must be smaller than 4mm.

10.4 Thermal Management

Full operation scenarios may prompt the use of an external heat dissipation solution.

The implemented solution design may vary depending on the device operation scenario as well as its mechanical design.

The following solution was implemented in the TRUX-iMX8MMini-Q01 evaluation kits.



Thermal conductive gap filler with similar performance to " TIF™700 Series Thermally Gap Filler "; appropriate thickness PN: TIF760P (1.5mm):

NOTE: The heat gap filler will allow a moderate heat generation on the SOM board to dissipate through the carrier board. In this case, it is recommended to have an exposed copper pad in the location of the thermal heat gap filler, on the top layer of the carrier board. **The copper pad should follow thermal pad design rules.**

Heat sink with an embedded double-sided adhesive with similar performance as **ATS-55250W-C1-R0**:

Link: <https://www.qats.com/Product/Heat-Sinks/BGA-Heat-Sink---High-Performance/Cross-Cut-Tape-On/ATS-55230W-C1-R0/608.aspx>