i.MX 8M MINI System-On-Module (SOM)

Hardware Architecture

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1. Introduction

This document describes the hardware architecture of the Emcraft Systems i.MX 8M System-on-Module (referred to as “IMX 8M MINI SOM” hereafter).

The i.MX 8M MINI System-On-Module (SOM) is a mezzanine module (60mm x 80mm) that combines the NXP i.MX 8M MINI multi-core application processor with up to 4GB DDR, up to 64GB eMMC and a WiFi / Bluetooth module on a single board. The i.MX 8M MINI features up to four Cortex-A53 cores at 1.8GHz and a Cortex-M4 core for low-power and real-time operation.

2. Hardware Platform

This section defines the hardware platform of the IMX 8M MINI SOM.

2.1. Hardware Platform Overview

The following are the key hardware features of the IMX 8M MINI SOM:

- Compact mezzanine module (60mm x 80mm);
- External interfaces using four 80-pin 0.4mm-pitch connectors;
- Four mounting holes reducing the risk of connector-to-PCB intermittence;
- Two mounting holes for attaching a heatsink;
- Compliant with the Restriction of Hazardous Substances (RoHS) directive;
- NXP i.MX 8M MINI microprocessor with Dual/Quad Cortex-A53 cores at 1.8GHz and a Cortex-M4 core for low-power and real-time operation;
- JTAG interface to the i.MX 8M MINI;
- Embedded Trace Macrocell (ETM);
- Powered from a single +5V power supply;
- Low-power operational modes with fast wake-up;
- 1-4GB LPDDR4 SDRAM;
- 4-64GB eMMC Flash;
- IEEE802.11a/b/g/n/ac W-LAN + Bluetooth 4.2/EDR;
- U.FL connector for WiFi & BT external antennas;
- Serial console interface at the UART CMOS levels;
- 1Gb Ethernet RGMII interface;
- Two USB 2.0 controllers with integrated PHY interfaces;
- PCI Express Gen2 interface;
- MIPI-DSI Display Interface (resolution up to 1920 x 1080 at 60 Hz);
- MIPI-CSI2 camera input (4-lane);
- Various digital (UART, SPI, I2C, SDHC, SAI, GPIO) interfaces of the i.MX 8M MINI available on the interface connectors.

2.2. Functional Block Diagram

The following figure is a functional block diagram of the IMX 8M MINI SOM:

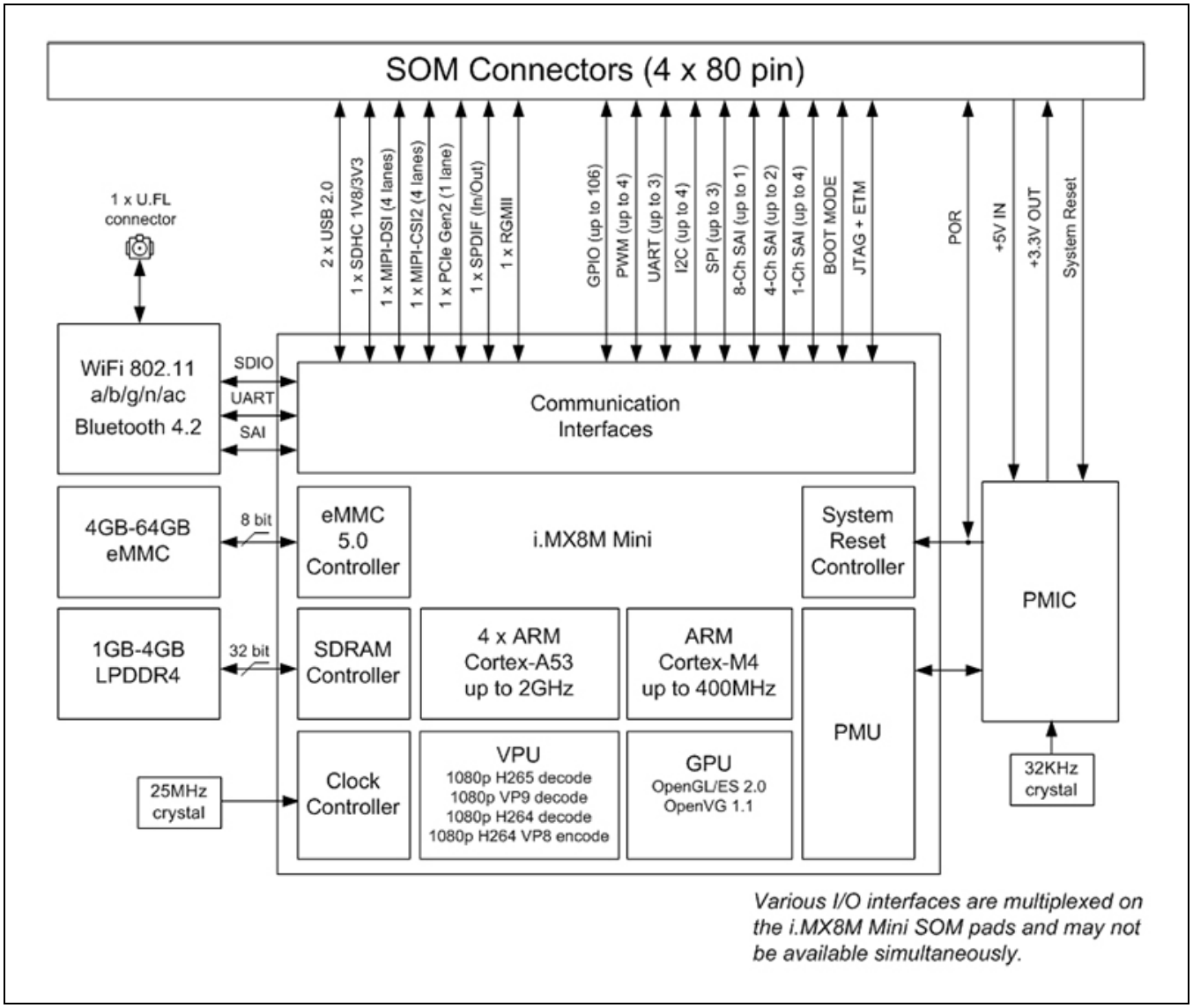

Figure 1: IMX 8M MINI SOM Functional Block Diagram

2.3. Microcontroller

2.3.1. Microcontroller Device

The architecture of the IMX 8M MINI SOM is built around the NXP i.MX 8M MINI microprocessor that combines the 1.8GHz Dual/Quad ARM Cortex-A53 processor cores with a 400MHz Cortex-M4 co-processor core as well as a wide range of the integrated peripheral controllers.

The i.MX 8M device is implemented using the 14mm x 14mm 0.5mm-pitch Map BGA package.

2.3.2. Microcontroller Configuration

The IMX 8M MINI SOM supports the following i.MX 8M device (SOM build-time options):

- MIMX8MM6DVTLZAA.

2.3.3. Microcontroller Boot Selection

The i.MX 8M MINI ROM code is configured to use the on-module eMMC Flash memory as the boot device. This is achieved by using the pre-programmed fuse configuration. The "Boot from Fuses" mode is set by 95kOhm internal pull-down resistors on the IMX 8M MINI BOOT0 and BOOT1 pins.

Note that the above boot pins are also routed to the SOM connector P3 (refer to Section 2.11.2). Care must be taken not to override the state of the above pins during boot time on a carrier board, otherwise the IMX 8M MINI SOM may fail to boot.

2.4. JTAG and ETM Interfaces

The Cortex-A53 and Cortex-M4 cores support debugging using real-time traces via the ETM interface as well as debugging via the JTAG interface.

The IMX 8M MINI SOM provides a standard JTAG interface on the interface connectors. This interface is routed to the corresponding signals of the i.MX 8M MINI device. The i.MX8M MINI provides internal 27k pull-up resistors on the JTAG pins.

The IMX 8M MINI SOM provides an ETM interface with a 4-bit data port on the interface connectors. The ETM interface shares pins with the SAI1 (refer to the imx8m-mini-som-pinout.xlsx file available from the Emcraft web site.)

2.5. Power

2.5.1. Power Source

The i.MX 8M MINI SOM is powered from a single +5V power source provided through multiple pins on the interface connectors.

The power source should provide at least 2A/10W power for the IMX8M-MINI-SOM to operate.

2.5.2. Power Control and Monitoring

Power control and monitoring on the IMX8M MINI SOM is implemented using the Rohm Power Control Integrated Circuit (PMIC) BD71847MWV-E2, designed specifically for the NXP i.MX8M MINI family of application processors.

The BD71847MWV-E2 provides Dynamic Voltage Scaling via I²C bus and/or digital input PMIC_STBY_REQ. The PMIC is accessible on the i.MX8M I2C1 bus for read and write at addresses 0x97 and 0x96, respectively.

2.5.3. Power Modes

The IMX 8M MINI SOM supports the following power modes:

- Full-power mode. This is the normal mode of operation. The main clock is running and the Cortex-A53 cores are running Linux. All memory controllers are enabled.
- Software is configured to enable only those i.MX 8M sub-systems that are used by installed device drivers; the clocks to all other sub-systems are gated off so those modules do not consume power.
- Low-power mode. This is Linux low-power mode, also referred to as the “Linux suspend-to-RAM” mode of operation. When Linux is commanded to enter the low-power mode, it transitions the SDRAM device to the self-refresh mode, ensuring that the Linux operational content is preserved across the low-power mode. The on-module WiFi/BT module is put into a low-power mode. The Cortex-A53 cores are put into appropriate low power modes.

  To put external (on-carrier) devices into low-power mode, the IMX 8M MINI SOM provides a dedicated output signal as a control for switching off-module (on carrier) devices to low-power modes, as appropriate. This active-low signal is implemented using an i.MX 88 GPIO and is available as GPIO1_IO08 on the interface connectors. When switching the system to the low-power mode, software activates the low-power mode signal. Off-module devices are expected to react to activation of that signal by switching themselves to low-power modes, as appropriate for the carrier design. Conversely, when software is switching back to full-power

mode, it de-asserts the low-power mode signal indicating to off-module devices that they are expected to switch back to the full-power mode.

The IMX 8M MINI SOM remains in the low-power mode until woken up by a configured trigger (such as, for instance, activation of a configured GPIO). On occurrence of a wake-up trigger, the IMX 8M MINI SOM returns to the full-power mode.

2.6. System Reset

2.6.1. Reset Architecture Overview

The IMX 8M MINI SOM implements a reset architecture that ensures that the i.MX 8M MINI microprocessor is reset as appropriate on various hardware and software events.

2.6.2. Types of System Resets

The following types of reset are implemented by the IMX 8M MINI SOM:

- Power-on reset. This type of reset occurs when the power is initially applied to the IMX 8M MINI SOM. As the supply voltage rises, the on-SOM PMIC holds the i.MX 8M MINI in reset until all the processor power supply voltages have risen above the appropriate voltage thresholds (90% of the nominal values). The internal i.MX 8M MINI power-on reset generation is disabled.
- Brown-out reset. In case any processor supply falls below/rises above its 80%/130% of its nominal voltage level, the PMIC generates a reset of the i.MX 8M MINI. After the brown-out reset has occurred, the PMIC holds the i.MX 8M in reset until all the supplies return to the range 90-110% of their nominal values.
- Software reset. This type of reset is activated by software running on the IMX 8M MINI SOM through performing the i.MX 8M MINI software reset sequence.
- External reset. To activate this type of reset, a baseboard drives low the SYS_nRST signal on the IMX 8M MINI SOM interface connectors. Activating this signal leads to the i.MX8M MINI SOM power cycle.

2.7. System Clocks

The IMX 8M MINI SOM provides 24MHz quartz crystal as the references to the internal oscillators of the i.MX 8M MINI microprocessor.

2.8. SDRAM

2.8.1. SDRAM Architecture

The IMX 8M MINI SOM provides 1-4GB of LPDDR4 SDRAM using one of the following device (build-time option):

- Micron MT53B256M32D1NP-062 WT:C;
- Micron MT53B512M32D2NP-062 WT:C (MT53B512M32D2NP-053 WT:C);
- Micron MT53B1024M32D4NQ-062 WT:C.

2.8.2. SDRAM Operational Mode

The i.MX 8M SDRAM controller operates in the LPDDR4 Mode. The DDR clock frequency of the SDRAM controller is 1600MHz.

2.9. eMMC

2.9.1. eMMC Architecture

The i.MX 8M MINI SOM provides 4-64GB of eMMC Flash interface using one of the following the devices (build-time option):

- Kigston EMMC04G-M627-X02U;
- Kigston EMMC08G-M325-X01U;
- Kigston EMMC16G-M525-X01U;
- Kigston EMMC32G-M525-X01U;
- Kigston EMMC64G-M525-X01U.

2.9.2. eMMC Operational Mode

The eMMC Flash operates in an 8-bit mode.

2.10. WiFi and Bluetooth

2.10.1. Wireless Architecture

The IMX8M-LPDDR4-SOM provides 802.11a/b/g/n/ac WLAN and Bluetooth 4.2/EDR functions. This is implemented with the Murata LBEE5ZZ1PJ-164 module which is based on the Qualcomm QCA9377-3 chipset.

2.10.1.1 WiFi

The W-LAN interface is supported via i.MX8M SD port 1.

2.10.1.2 Bluetooth

Bluetooth is supported via the i.MX8M UART1 (data path). The UART3 data path pins (TXD and RXD) are used as a UART1 flow control.

The Bluetooth digital audio is provided with the i.MX8M SAI2 (in the PCM mode).

2.10.2. WiFi & BT Connectors

The IMX8M MINI SOM provides one U.FL connector (J2) for external WiFi/BT antenna.

The Molex 1461530100 antenna is recommended for using with the IMX8M MINI SOM.

The placeholders L3, L4, R44 are reserved on the IMX8M-MINI-SOM for external antennas matching circuits. By default, only 0-Ohm R44 is installed.

2.11. External Interface

2.11.1. Board to Board Interface Connectors

The external interfaces of the IMX 8M MINI SOM are routed through four 80-pin Hirose DF40 series 0.4mm-pitch board-to-board connectors.

2.11.2. Connectors Pin-Out

Refer to the imx8m-mini-som-pinout.xlsx file available from the Emcraft web site for the detailed information on connectors pin-out.

3. Mechanical Specifications

3.1. IMX 8M MINI SOM Mechanicals

The IMX 8M MINI SOM is implemented as a 60mm x 80mm x 4.8mm module (without a processor heatsink and the bottom side connectors).

The IMX 8M MINI SOM PCB thickness is 1.6+/- 0.16mm. The maximum height of the SOM components on the top and bottom sides of the module is 2.2mm and 1mm respectively.

The IMX 8M MINI SOM includes four 2.3mm mounting holes for fastening the SOM to a baseboard and two 3.1mm mounting holes for attaching a heatsink to the i.MX8M package.

The following figure shows the location of the mounting holes and the SOM connectors on the module:

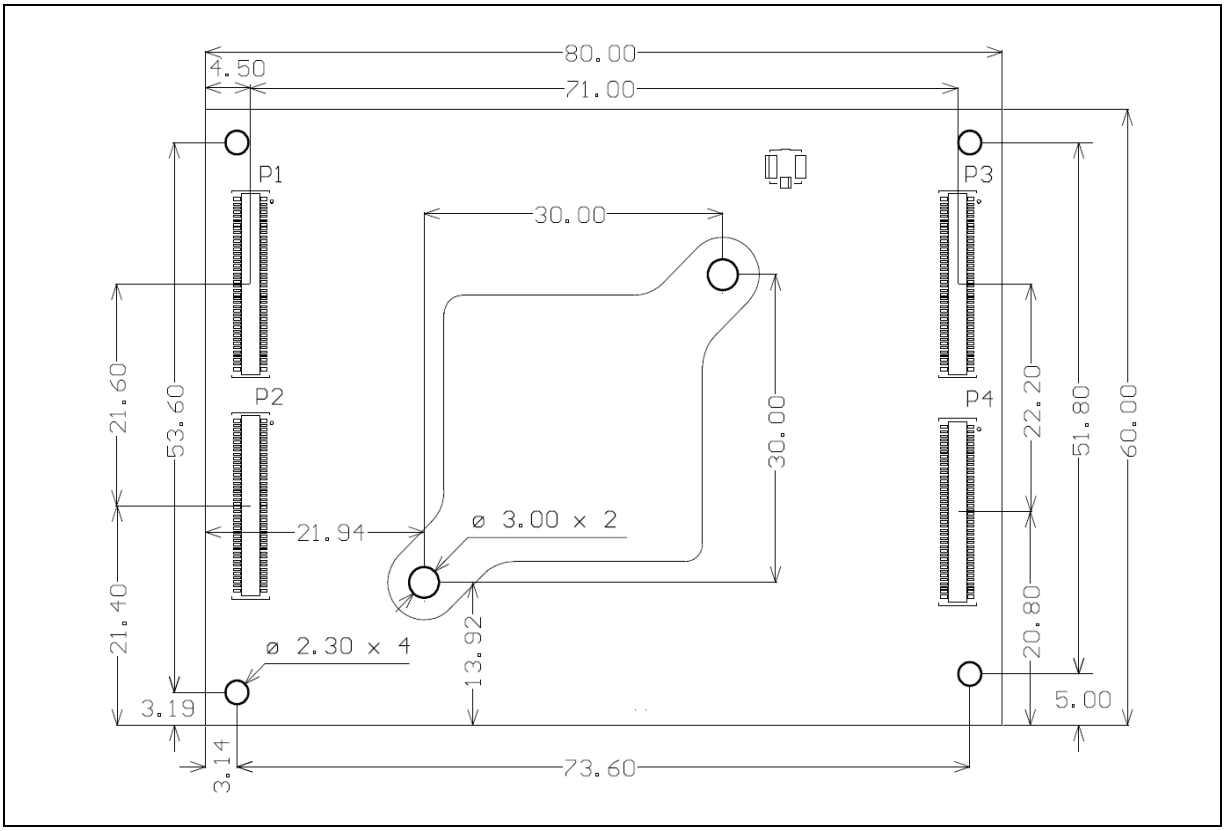

Figure 2: IMX 8M MINI SOM Top View

Connectors P1— P4 are on the bottom side. All dimensions are in millimeters.

3.2. IMX 8M MINI SOM Connectors Mechanicals

On a baseboard, the IMX 8M MINI SOM is installed into four 80-pin Hirose DF40 series 0.4mm-pitch board-to-board connectors. The exact part number of the connectors is Hirose DF40C-80DP-0.4V.

The recommended mating connectors for a baseboard is the Hirose DF40C-80DP-0.4V connector, which provides 4mm stacking height for the IMX 8M MINI SOM. The maximum height of the SOM above a baseboard for 3mm stacking height is 7.8mm without a processor heatsink.

3.3. IMX 8M MINI SOM Top and Bottom Views

The following pictures provide the top and bottom views of the IMX 8M MINI SOM:

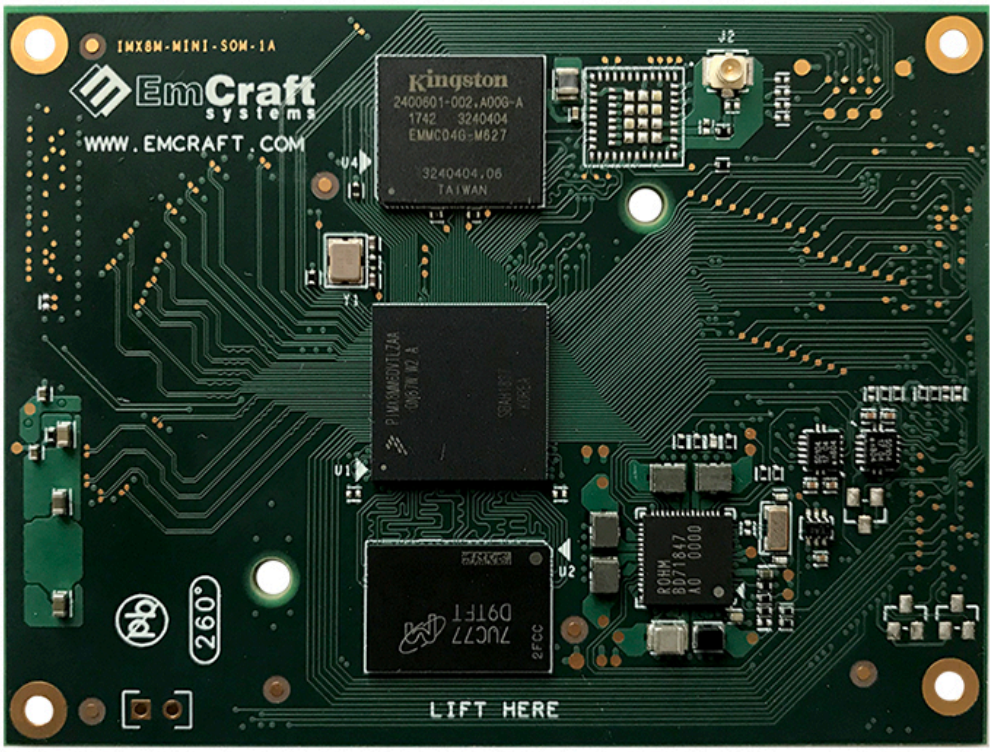

Figure 3: IMX 8M MINI SOM Top View

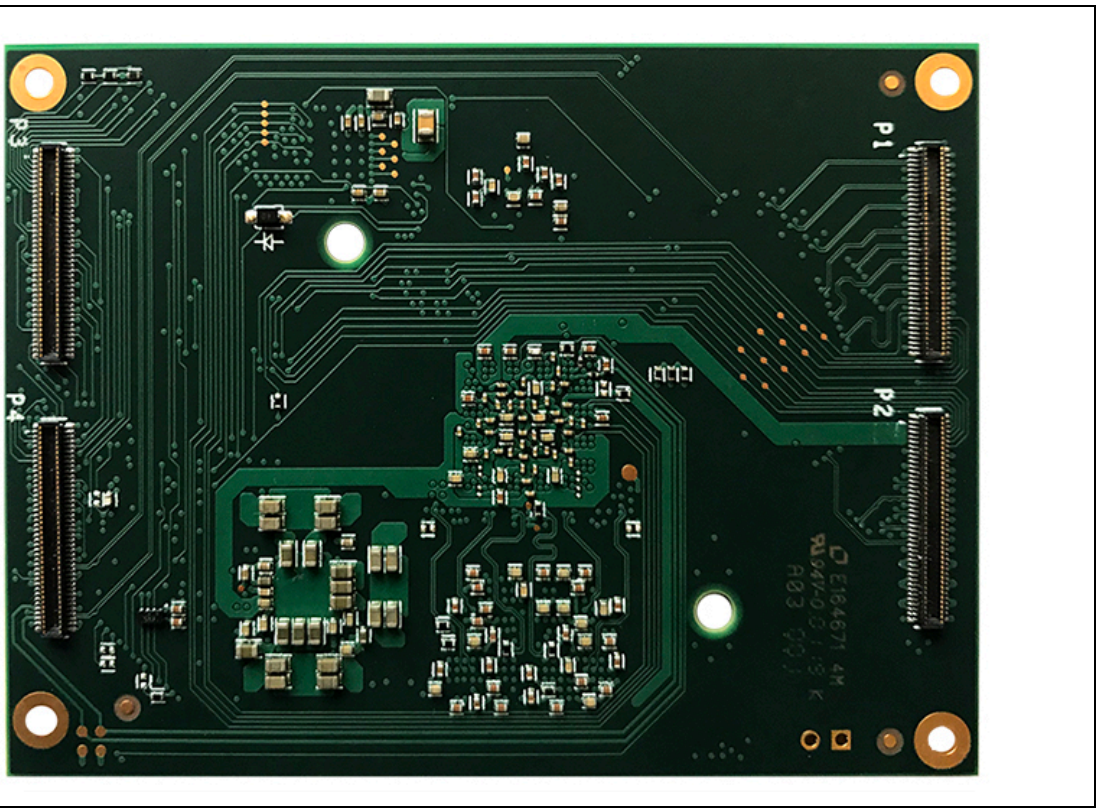

Figure 4: IMX 8M MINI SOM Bottom View

4. Environment Specifications

4.1. Recommended Operating Conditions

The following table lists the recommended operating conditions of the IMX 8M MINI SOM:

Symbol	Parameter	Range	
T_A	Ambient temperature	Commercial	0 to +70 ºC
PMIC_5V	+5V power supply	+5V +/-5%	

Table 1: Recommended Operating Conditions

5. Document Revision History

Revision	Date	Changes Summary
1.0	February 26, 2019	Initial version