



# ConnectCore 8X

System-on-module

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Hardware Reference Manual -- Preliminary

## Revision history—90002295

| Revision | Date          | Description                                                                                                                                                              |
|----------|---------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1P       | December 2018 | Initial release                                                                                                                                                          |
| 2P       | January 2019  | Added backdrive caution.                                                                                                                                                 |
| 3P       | May 2019      | Updated entire manual, including entire MCA section, some pin data, block diagram, and assembly information.                                                             |
| 4P       | March 2020    | Added North American certifications; added power consumption section; updated frequency value, variants information, and some graphics; updated MCA to trademarked name. |
| 5P       | May 2020      | Added operating temperature statement.                                                                                                                                   |
| 6P       | June 2020     | Added Canada, Europe, and Japan certifications; added FCC notices; added antenna port section.                                                                           |

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## About the ConnectCore® 8X

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The ConnectCore 8X is a secure and extremely cost-effective connected System-on-Module platform. Its innovative Digi SMTplus™ (patent-pending) surface mount form factor allows you to choose simplified design integration leveraging proven and easy-to-use edge-castellated SMT technology, or a versatile LGA option for ultimate design flexibility with access to virtually all interfaces.

Built on the NXP i.MX 8X application processor, the module is the intelligent communication engine for today's secure connected devices. It integrates dual-Ethernet and pre-certified dual-band Wi-Fi (802.11a/b/g/n/ac) with dual mode Bluetooth 5.0 connectivity.

## Features and functionality

The ConnectCore 8X System-on-module is based on the i.MX 8X processor from NXP. This processor offers a number of interfaces, some of them multiplexed and not available simultaneously. The module has the following features:

- i.MX 8X dual/quad Arm Cortex-A35 and single Cortex-M4F cores:
  - Cortex-A35 cores operate up to 1.0 GHz and support Arm virtualization extensions.
  - Cortex-M4F core operates up to 266 MHz.
  - AArch64 for 64-bit support.
  - AArch32 for backward compatibility with Armv7.
- System Control Unit (SCU):
  - Power control, clocks, and reset.
  - Boot ROMs.
  - PMIC interface.
  - Resource Domain Controller.
- Graphics Processing Unit (GPU):
  - 4x Vec4 shaders with 16 execution units.
  - Supports OpenGL 3.0, 2.0; OpenGL ES 3.1, 3.0, 2.0 and 1.1; OpenCL 1.2 FP and 1.1; OpenVG 1.1; and Vulkan.
  - High-performance 2D Blit Engine.
- Video Processing Unit (VPU):
  - H.265 decode (4Kp30).
  - H.264 decode (1080p60).
  - VP6/VP8 decode (1080p60).
  - MPEG-2 decode (1080p60).
  - MPEG4, H263, Sorenson Spark decode (1080p).
  - RealVideo decode (1080p).
  - JPEG dec (64Kx64K image size).
  - H.264 encode (1080p30).

- Up to 4 GB, 32-bit LPDDR4-1200 memory.
- 16 GB, 8-bit eMMC memory. Higher density available depending on product variant.
- NXP PF8100 Power Management IC (PMIC):
  - 7x DC/DC buck converters.
  - 4x LDO regulators.
  - OTP (one-time-programmable) memory.
  - Coin cell charger.
- CryptoAuthentication device.
- Security accelerators:
  - Enhanced High Assurance Boot (HAB) secure and encrypted boot.
  - Random Number Generator with a high-quality entropy source generator and NIST certifiable HMAC-based DRBG.
  - RSA up to 4096, Elliptic Curve up to 1023.
  - AES-128/192/256, DES, 3DES, ARC4, MD5, SHA-1, SHA-224/256/384/512.
  - Dedicated Security Controller for Flashless SHE and HSM support, Trustzone, RTIC.
  - Built-in ECDSA/DSA protocol support.
  - 10x tamper pins: up to 5 active or 10 passive.
  - Voltage and temperature tamper detection to help prevent against side-channel style attacks.
  - 64 kB Secure RAM (can be erased via tamper detection).
- 2x2 MIMO IEEE802.11 a/b/g/n/ac.
- Bluetooth 5.0.
- Debug interfaces:
  - System JTAG controller.
  - Single Wired Debug (SWD) interface for the MCA.
- i.MX 8X interfaces:
  - PCIe 3.0 with L1 substate support. In wireless modules, this interface is used by the Wireless MAC and is not available for general purposes.
  - 1x USBOTG 3.0 with PHY - USB 3.0 can be used as USB 2.0.
  - 1x USBOTG 2.0 (with PHY).
  - 2x Gb Ethernet with AVB.
  - 3x CAN/CAN-FD.
  - Media Local Bus (MLB25/50).
  - 6x UARTs:
    - 4x UARTs, three of which support hardware flow control. (One of the UARTs with hardware flow control is used by the Bluetooth and is not available for general purposes in wireless variants.)
    - 1x UART tightly coupled with Cortex-M4F cores.
    - 1x SCU (not available for general use).
  - 10x I2C. Note that I2C ports associated with a specific PHY (e.g. MIPI DSI) can be used generally but require the PHY to be powered on even if the PHY itself is not used:

- 4x I2C: High Speed, DMA support. One of them (I2C0) is used internally in the SOM and is not available for general purposes.
  - 4x I2C: Low Speed, no DMA support.
  - 1x I2C: PMIC control (dedicated).
  - 1x I2C: Cortex M4F (dedicated).
- 4x SAI:
  - SAI0 and SAI1 are transmit/receive.
  - SAI2 and SAI3 are receive-only.
- 2x Quad SPI or 1x Octal SPI (FlexSPI).
- 1x SD 3.0 card interface.
- Displays:
  - 2x MIPI-DSI/LDVS. For LVDS, VESA and JEIDA standards supported.
  - 1x 24-bit parallel display up to WVGA.
- Cameras:
  - 1x MIPI-CSI camera with 4 lanes.
  - 1x 8-bit parallel CSI.
- 1x Enhanced Serial Audio Interface (ESAI).
- 2x ASRC (Asynchronous Sample Rate Converter).
- 1x SPDIF.
- MPEG-2 Transport Stream.
- 1x 12-bit, 6 channel ADC converter.
- 3.3 V/1.8 V GPIO.
- 4x PWM channels.
- 1x 4x4 KPP (Key Pad Port).
- 1x MQS (Medium Quality Sound).
- 4x SPI.
- Arm Cortex-M0+ Digi Microcontroller Assist™ (MCA) subsystem:
  - Cortex-M0+ core operates up to 48MHz.
  - Power and reset control.
  - Real time clock (RTC).
  - 19 general purpose IOs (GPIOs), all IRQ capable with debouncing configuration.
  - 9 analog to digital converters (ADCs), all with comparator capabilities.
  - Watchdog.
  - Tamper detection, both digital and analog.
  - 8 bytes of non volatile storage (NVRAM).
  - 3 UARTs, with optional hardware handshake.
  - 10 pulse width modulators (PWMs).

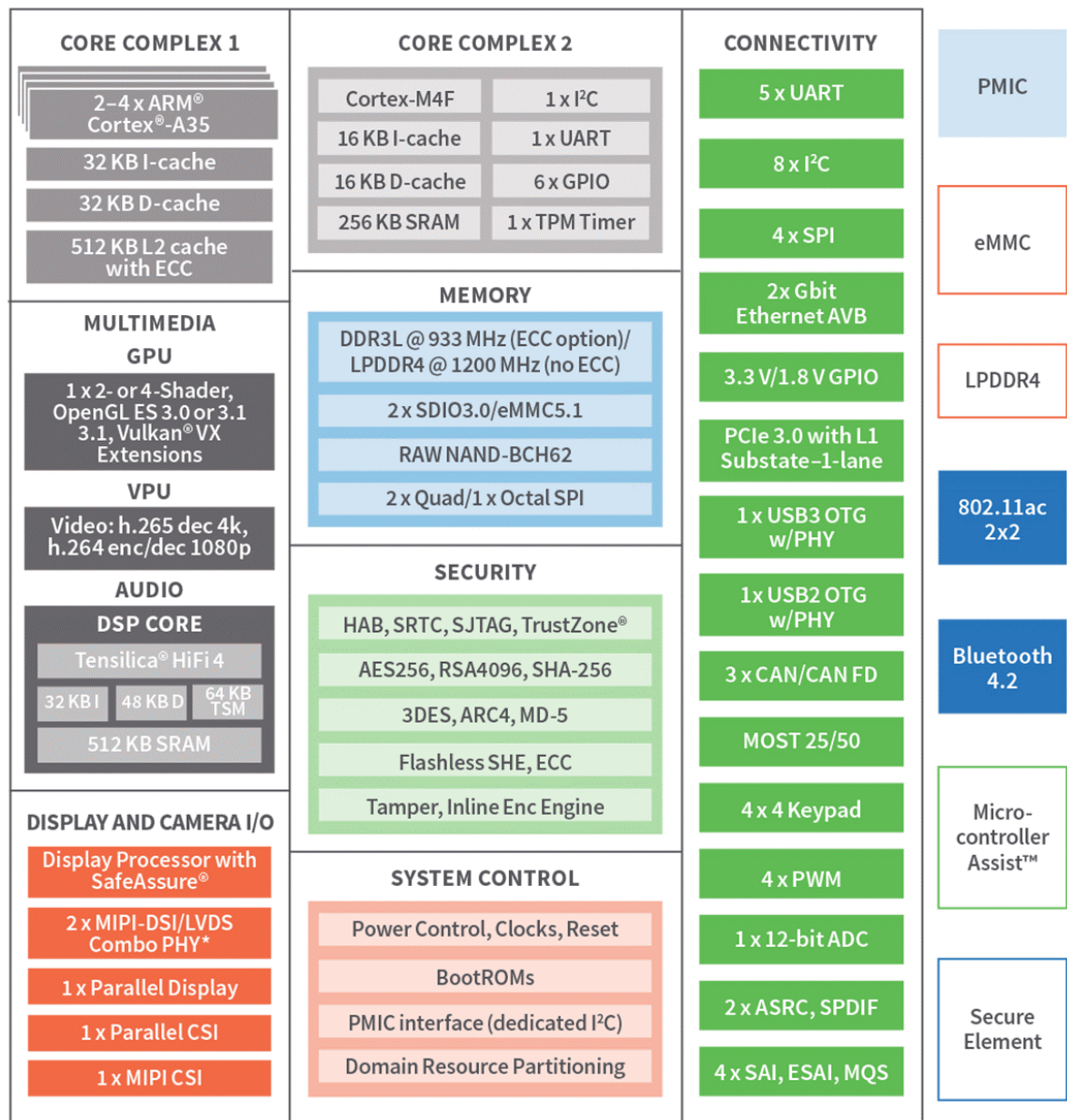
## Module variants

See the full list of variants in the [ConnectCore 8X documentation portal](#).

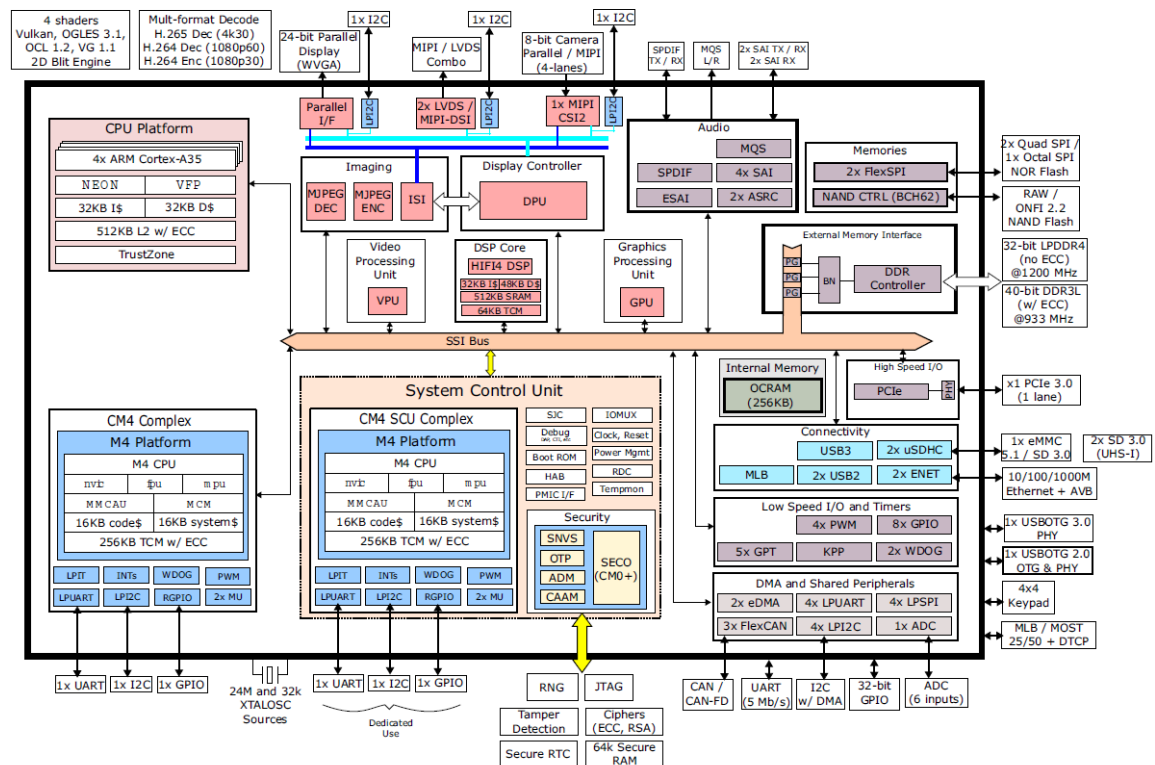
## Block diagrams

The following figures show block diagrams of the ConnectCore 8X module and of the NXP i.MX 8X application processor.

### ConnectCore 8X module



## NXP i.MX 8X application processor



## SOM revisions

The ConnectCore 8X SOM uses an NXP i.MX8X system-on-chip (SOC). NXP released two revisions of the system-on-chip (SOC) silicon:

- Revision **B0**
- Revision **C0**

On the **C0** revision of the i.MX8X, NXP fixed most of the errata that were reported on B0. For a full list of fixes, see [NXP Application Note AN12770](#).

## Identify the SOC revision of your SOM

The label on the ConnectCore 8X SOM looks like this:



The red circle denotes Digi's revision of the ConnectCore 8X SOM. The following table correlates the ConnectCore 8X SOM revision with the i.MX8X SOC revision:

| SOM revision | Description            | i.MX8X SOC revision |
|--------------|------------------------|---------------------|
| 1P, 2P, ...  | Pre-production series  | B0                  |
| A, B, ...    | Mass production series | C0                  |

**Note** See the [SOC revisions](#) section of the ConnectCore 8X software documentation portal for more information.

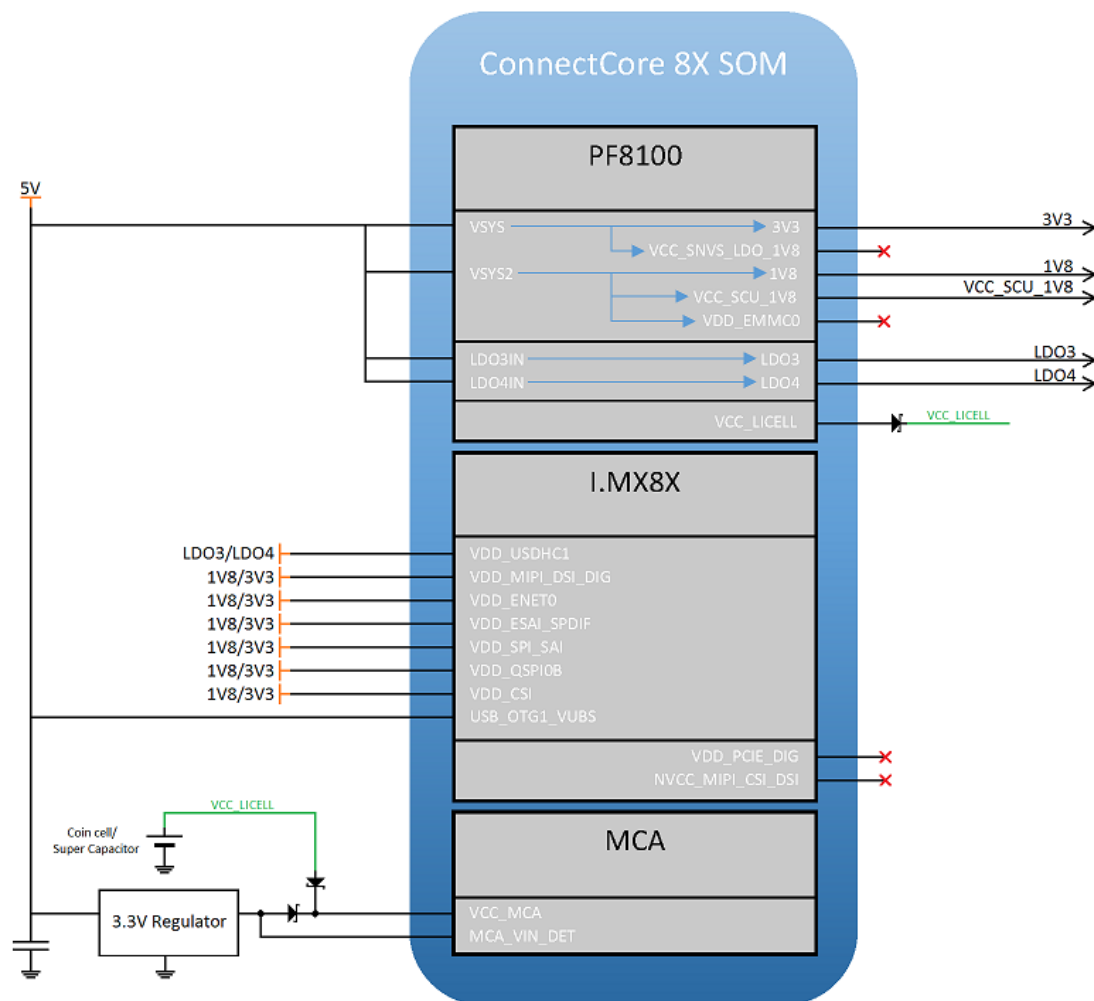
## The ConnectCore 8X System-on-module

This section describes the functionality of the ConnectCore 8X System-on-module.

### Power interfaces

#### Reference power architecture scheme

The following diagram represents the full power architecture distribution of the ConnectCore 8X module in a typical application with the coin cell charger functionality supported:



## System-on-module power rails distribution

The ConnectCore 8X requires three primary power supply inputs: VSYS, VSYS2, and VCC\_MCA:

- VSYS and VSYS2 are the input power supplies to the on-module NXP PF8100 Power Management IC (PMIC), as well as to most of its regulators. Some PMIC regulators are internally dedicated to powering the module, while others power external circuitry.
- VCC\_MCA is the input power supply of the on-module Digi Microcontroller Assist.

Two additional linear dropout regulators (LDO3 and LDO4), which have a dedicated input power line, are available to power carrier board external circuitry. These additional regulators are not mandatory.

The following table summarizes the PMIC regulators of the ConnectCore 8X SOM:

| PMIC regulator | SoM power rail name | Input power supply | Internally used | Externally available | Comments                                                                                                                             |
|----------------|---------------------|--------------------|-----------------|----------------------|--------------------------------------------------------------------------------------------------------------------------------------|
| SW1            | -                   | VSYS2              | <b>YES</b>      | <b>NO</b>            |                                                                                                                                      |
| SW2            | -                   | VSYS2              | <b>YES</b>      | <b>NO</b>            |                                                                                                                                      |
| SW3            | -                   | VSYS2              | <b>YES</b>      | <b>NO</b>            |                                                                                                                                      |
| SW4            | -                   | VSYS2              | <b>YES</b>      | <b>NO</b>            |                                                                                                                                      |
| SW5            | -                   | VSYS2              | <b>YES</b>      | <b>NO</b>            |                                                                                                                                      |
| SW6            | 1V8                 | VSYS2              | <b>YES</b>      | <b>YES</b>           | General purpose 1.8V power rail for external circuitry. Also used internally in the SOM.                                             |
| SW7            | 3V3                 | VSYS               | <b>YES</b>      | <b>YES</b>           | General purpose 3.3V power rail for external circuitry. Also used internally in the SOM.                                             |
| LDO1           | VCC_SCU_1V8         | VSYS2              | <b>YES</b>      | <b>YES</b>           | Power supply for the i.MX 8X System Control Unit (SCU). Digi recommends not using this power rail externally unless otherwise noted. |
| LDO2           | VDD_EMMC0           | VSYS2              | <b>YES</b>      | <b>YES</b>           | Used for powering the internal eMMC0 memory. Digi recommends not using this power rail externally unless otherwise noted.            |
| LDO3           | LDO3                | LDO3IN             | <b>NO</b>       | <b>YES</b>           |                                                                                                                                      |
| LDO4           | LDO4                | LDO4IN             | <b>NO</b>       | <b>YES</b>           |                                                                                                                                      |

| PMIC regulator                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | SoM power rail name | Input power supply | Internally used | Externally available | Comments                                                                                                                    |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|--------------------|-----------------|----------------------|-----------------------------------------------------------------------------------------------------------------------------|
| VSNVS                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | VCC_SNVS_LDO_1V8    | VSYS / VCC_LICELL  | <b>YES</b>      | <b>YES</b>           | An always-on power domain of the CPU that powers some core functionality of the SOM. Do not use this power rail externally. |
| <p><b>Note</b> VCC_LICELL is the input power for the PMIC VSNVS regulator, which is normally used to power the CPU in low-power mode (RTC). This pin also supports coin cell charger functionality for Li-ion rechargeable batteries or supercapacitors. However, RTC mode in the ConnectCore 8X is supported by the ConnectCore 8X MCA, not by the i.MX 8X. Therefore, in order to supply the RTC of the system, do not use VCC_LICELL as an input power rail. Instead, follow the configuration explained in <a href="#">RTC power and coin cell charger</a>.</p> |                     |                    |                 |                      |                                                                                                                             |

In addition to the input power supplies of the PMIC, other power domains of the SOM must also be set externally. This allows power management flexibility so you can adapt the input voltage of the different interfaces. The following table lists the input power rails that must be powered externally to the SOM together with the devices/power domains they power:

| Input rail | Device being powered        | Internal power domains being powered | Description                                                                    |
|------------|-----------------------------|--------------------------------------|--------------------------------------------------------------------------------|
| VCC_MCA    | Digi Microcontroller Assist | Full device                          | Input power supply for the ConnectCore 8X MCA. This power domain is mandatory. |

| Input rail       | Device being powered | Internal power domains being powered                                                                                                                | Description                                                                                                                                                                                                                                                                                                            |
|------------------|----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| VDD_USDHC1       | i.MX 8X CPU          | VDD_USDHC1_1P8_3P3                                                                                                                                  | Input power supply for the USDHC1 interface. This interface is typically connected to a microSD socket, which also allows booting from the microSD card. Digi recommends that this power domain be connected to a flexible power supply (LDO3/4) so it can work at its highest speed by adjusting input voltage level. |
| VDD_MIPI_DSI_DIG | i.MX 8X CPU          | VDD_MIPI_DSI_DIG_1P8_3P3                                                                                                                            | Input power supply for DSI0 and DSI1 dedicated GPIOs and I2C buses.                                                                                                                                                                                                                                                    |
| VDD_ENET0        | i.MX 8X CPU          | <ul style="list-style-type: none"> <li>■ VDD_ENET0_VSELECT_1P8_2P5_3P3</li> <li>■ VDD_ENET0_1P8_2P5_3P3</li> <li>■ VDD_ENET_MDIO_1P8_3P3</li> </ul> | Input power supply for the ENET0 interface, including the MDIO bus. Because all ENET0-related CPU blocks are powered from the same power rail, 2.5V configuration is not available. (The MDIO bus does not work at this voltage.)                                                                                      |

| Input rail     | Device being powered | Internal power domains being powered                                                                | Description                                                  |
|----------------|----------------------|-----------------------------------------------------------------------------------------------------|--------------------------------------------------------------|
| VDD_ESAI_SPDIF | i.MX 8X CPU          | VDD_ESAI_SPDIF_1P8_2P5_3P3                                                                          | Input power supply for ESAI0 and SPDIF0 interfaces.          |
| VDD_SPI_SAI    | i.MX 8X CPU          | VDD_SPI_SAI_1P8_3P3                                                                                 | Input power supply for SAI0, SAI1, SPI0 and SPI2 interfaces. |
| VDD_QSPI0B     | i.MX 8X CPU          | VDD_QSPI0B_1P8_3P3                                                                                  | Input power supply for QSPI0B interface.                     |
| VDD_CSI        | i.MX 8X CPU          | <ul style="list-style-type: none"> <li>■ VDD_TMPR_CSI_1P8_3P3</li> <li>■ VDD_CSI_1P8_3P3</li> </ul> | Input power supply for CSI interface.                        |
| USB_OTG1_VBUS  | i.MX 8X CPU          | USB_OTG1_VBUS                                                                                       | Input power supply for the USB1 interface VBUS.              |

Two additional power domains of the CPU are connected to the module LGA pads:

- VDD\_PCIE\_DIG
- NVCC\_MIPi\_CSI\_DSI

These power domains are powered internally in the SOM and must not be connected to external circuitry unless otherwise noted.

## Electrical characteristics

### Input power rails

The following table lists the electrical specifications of all input power rails for the ConnectCore 8X:

| Device | SOM power rail | Input voltage (V) |         |         |
|--------|----------------|-------------------|---------|---------|
|        |                | Minimum           | Typical | Maximum |
| PMIC   | VSYS           | TBD<br>(2.7)      | -       | 5.5     |
|        | VSYS2          | TBD<br>(3.0)      | -       | 5.5     |

| Device     | SOM power rail                                                                                                                |            | Input voltage (V) |         |         |
|------------|-------------------------------------------------------------------------------------------------------------------------------|------------|-------------------|---------|---------|
|            |                                                                                                                               |            | Minimum           | Typical | Maximum |
|            | <b>LDO3IN</b>                                                                                                                 |            | 2.5 <sup>1</sup>  | -       | 5.5     |
|            | <b>LDO4IN</b>                                                                                                                 |            | 2.5 <sup>1</sup>  | -       | 5.5     |
| <b>MCA</b> | <b>VCC_MCA</b>                                                                                                                |            | 2.4               | -       | 3.6     |
| <b>CPU</b> | <b>VDD_USDHC1</b><br><b>VDD_MIPI_DSI_DIG</b><br><b>VDD_ENET0</b><br><b>VDD_SPI_SAI</b><br><b>VDD_QSPI0B</b><br><b>VDD_CSI</b> | 1.8 V mode | 1.65              | 1.8     | 1.95    |
|            |                                                                                                                               | 3.3 V mode | 3.00              | 3.30    | 3.60    |
|            |                                                                                                                               | 1.8 V mode | 1.65              | 1.8     | 3.60    |
|            | <b>VDD_ESAI_SPDIF</b>                                                                                                         | 2.5 V mode | 2.40              | 2.50    | 2.60    |
|            |                                                                                                                               | 3.3 V mode | 3.00              | 3.30    | 3.60    |
|            | <b>USB_OTG1_VBUS</b>                                                                                                          |            | 4.4               | -       | 5.5     |

---

<sup>1</sup>When VLDOx is greater than 2.5V, minimum input voltage for the LDOs will be the nominal output voltage plus 0.25V.

## Output power rails

The following table lists the electrical specifications of all output power rails for the ConnectCore 8X:

| Device |       | SOM power rail                 |                | Used internally in the SOM | Output voltage (V) |      |     | Accuracy (%) |     |     | Max output current (mA) <sup>1</sup> | Turn-on time (us) |     |     | Turn-off time (us) |     |      |
|--------|-------|--------------------------------|----------------|----------------------------|--------------------|------|-----|--------------|-----|-----|--------------------------------------|-------------------|-----|-----|--------------------|-----|------|
|        |       |                                |                |                            | Min                | Typ  | Max | Min          | Typ | Max |                                      | Min               | Typ | Max | Min                | Typ | Max  |
| PMIC   | SW6   | 1V8                            |                | YES                        | -                  | 1.80 | -   | -2.0         | -   | 2.0 | 2500                                 | 36                | 160 | 279 | -                  | -   | -    |
|        | SW7   | 3V3                            |                | YES                        | -                  | 3.30 | -   | -2.0         | -   | 2.0 | 2500                                 | -                 | -   | 200 | -                  | -   | -    |
|        | LD01  | VCC_SCU_1V8                    |                | YES                        | -                  | 1.80 | -   | -3.0         | -   | 3.0 | 400                                  | -                 | -   | 500 | -                  | -   | 2500 |
|        | LD02  | VDD_EMMC0                      |                | YES                        | -                  | 3.30 | -   | -3.0         | -   | 3.0 | 400                                  | -                 | -   | 500 | -                  | -   | 2500 |
|        | LD03  | LDO3                           |                | NO                         | 1.5                | -    | 5.0 | -3.0         | -   | 3.0 | 400                                  | -                 | -   | 500 | -                  | -   | 2500 |
|        | LD04  | LDO4                           |                | NO                         | 1.5                | -    | 5.0 | -3.0         | -   | 3.0 | 400                                  | -                 | -   | 500 | -                  | -   | 2500 |
|        | VSNVS | VCC_LICELL (coin cell charger) | 2.6 V to 3.6 V | YES                        | 1.8                | -    | 3.6 | -3.0         | -   | 3.0 | 0.060                                |                   |     |     |                    |     |      |
|        |       |                                | 1.8 V to 2.5 V | YES                        |                    |      |     | -4.0         | -   | 4.0 |                                      |                   |     |     |                    |     |      |

**Note** For a complete description of the electrical characteristics of the different output power rails (PMIC regulators), see the NXP PF8x00 datasheet.

<sup>1</sup> The maximum output current involves both external and internal circuitry. For those regulators that are used internally in the SOM, the current available outside it will be lower.

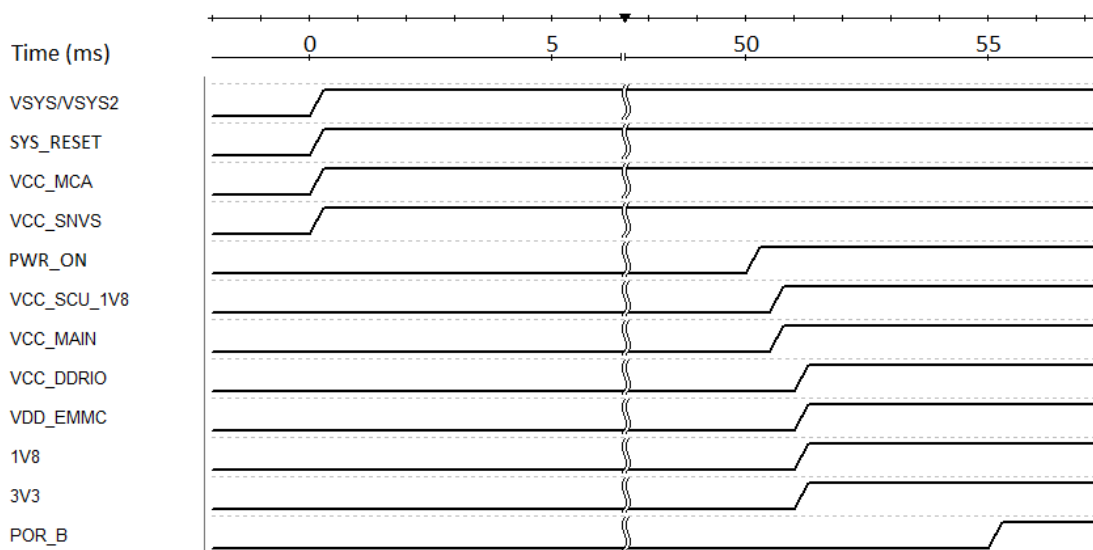
<sup>2</sup> Turn-on time for this regulator is specified for VSW7 = 1.8 V. In the ConnectCore 8X this regulator is configured to work at 3.3V, so a higher turn-on time may be observed.

## System power-up sequence

When the power supply is connected to the ConnectCore 8X module, the PMIC and the MCA are the first components to be powered up. VSYS and VSYS2 are PMIC supplies, while VCC\_MCA is the Digi Microcontroller Assist input power line. The system power-up sequence is as follows:

1. The MCA starts to run as soon as it is powered up. After a certain programmable time, it will release the PWRON line of the PMIC (PMIC power on/off).
2. Once the PMIC is switched on, it starts an initialization process as determined by its OTPs. Finally the CPU reset line, which is controlled by both the PMIC and the MCA, is released.

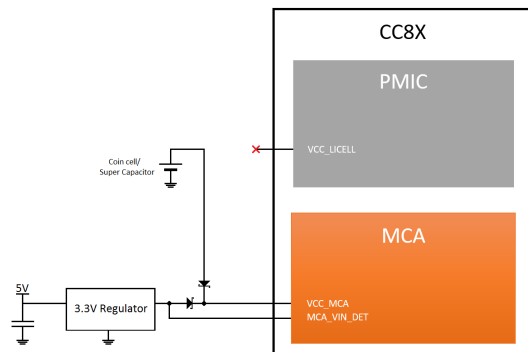
The following time diagram shows the power-up sequence.



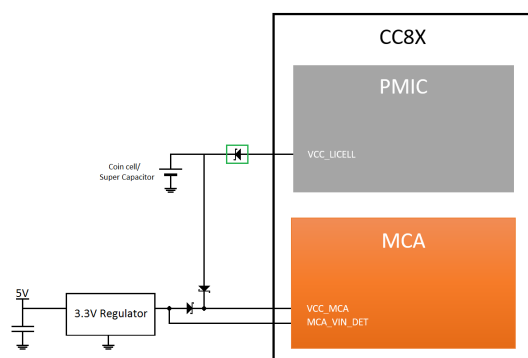
## RTC power and coin cell charger

The VCC\_LICELL pin supports coin cell charger functionality. This pin is also the input power supply for an always-on regulator of the PMIC (VSNVS) that feeds the low-power mode circuitry of the CPU. In the ConnectCore 8X module, the low-power modes of the system (RTC) are supported by the on-module MCA, not by the i.MX 8X CPU. Therefore, in order to reduce the static power consumption of the SOM, do not power the VSNVS regulator in low power mode. The coin cell should only power the VCC\_MCA power domain through the diode configuration as shown in the following diagrams.

If the coin-cell charger functionality is mandatory, place a reverse diode between VCC\_LICELL and the coin cell.

**RTC connection without coin cell charger****RTC connection with coin cell charger**

**Note** This hardware configuration has been validated with the Panasonic DB2J31400L diode, which has a low reverse leakage current (300nA) that is ideal for this low-power mode application.

**Bootstrap**

The ConnectCore 8X module can be configured to boot from different devices and interfaces as determined by the Boot ROM. The configuration of the booting process of the CPU is done through the SCU (System Control Unit) boot mode.

The BOOT\_MODE is initialized by the SCU at the rising edge of POR\_B, when it latched the SCU\_BOOT\_MODE lines. Once these lines are sampled, the subsequent state does not affect the content of the BOOT\_MODE, which is tracked by the SCU.

The following table describes the eight boot modes that are supported by the ConnectCore 8X module:

| BOOT_MODE [3] | BOOT_MODE [2] | BOOT_MODE [1] | BOOT_MODE [0] | Boot mode        |
|---------------|---------------|---------------|---------------|------------------|
| 0             | 0             | 0             | 0             | Boot from eFuses |

| BOOT_MODE [3] | BOOT_MODE [2] | BOOT_MODE [1] | BOOT_MODE [0] | Boot mode                     |
|---------------|---------------|---------------|---------------|-------------------------------|
| 0             | 0             | 0             | 1             | USB serial download           |
| 0             | 0             | 1             | 0             | USDHC Boot: eMMC0             |
| 0             | 0             | 1             | 1             | USDHC Boot: USDHC1            |
| 0             | 1             | 0             | 0             | NAND Boot: 128 pages in Block |
| 0             | 1             | 0             | 1             | NAND Boot: 32 pages in Block  |
| 0             | 1             | 1             | 0             | FlexSPI Boot: 3B read         |
| 0             | 1             | 1             | 1             | FlexSPI Boot: Hyperflash 3.0  |

These BOOT\_MODE lines are referred to the VCC\_SCU\_1V8 power domain. By default, none of them are configured inside the module. To configure the desired boot mode, they must be driven low or high in the carrier board in the following way:

- To set high level, place a 4.7K pull-up to VCC\_SCU\_1V8.
- To set low level, place a 100K pull-down to GND.

## Wireless interfaces

The ConnectCore 8X System-on-module combines a wireless local area network (WLAN) and Bluetooth dual solution to support MIMO 2x2 IEEE802.11 a/b/g/n/ac WLAN standards and Bluetooth 5.0, enabling seamless integration of WLAN/Bluetooth and Low Energy technology.

### WLAN IEEE 802.11a/b/g/n/ac

The 2.4 GHz band on the ConnectCore 8X module supports 20/40 MHz bandwidths, and the 5 GHz band supports 20/40/80 MHz bandwidths. The following sections specify the performance of the WLAN IEEE 802.11a/b/g/n/ac interface on the ConnectCore 8X module.

#### Modulation and data rates

The following tables list modulation values for the ConnectCore 8X module, which supports the following WLAN standards:

| Mode    | Modulation & coding | Rate     |
|---------|---------------------|----------|
| 802.11b | DBPSK               | 1 Mbps   |
|         | DQPSK               | 2 Mbps   |
|         | CCK                 | 5.5 Mbps |
|         | CCK                 | 11 Mbps  |

| Mode     | Modulation & coding | Rate    |
|----------|---------------------|---------|
| 802.11ga | BPSK-1/2            | 6 Mbps  |
|          | BPSK-3/4            | 9 Mbps  |
|          | QPSK-1/2            | 12 Mbps |
|          | QPSK-3/4            | 18 Mbps |
|          | 16QAM-1/2           | 24 Mbps |
|          | 16QAM-3/4           | 36 Mbps |
|          | 64QAM-2/3           | 48 Mbps |
|          | 64QAM-3/4           | 54 Mbps |
| 802.11n  | BPSK-1/2            | MCS0    |
|          | QPSK-1/2            | MCS1    |
|          | QPSK-3/4            | MCS2    |
|          | 16QAM-1/2           | MCS3    |
|          | 16QAM-3/4           | MCS4    |
|          | 64QAM-2/3           | MCS5    |
|          | 64QAM-3/4           | MCS6    |
|          | 64QAM-5/6           | MCS7    |
| 802.11ac | BPSK-1/2            | MCS0    |
|          | QPSK-1/2            | MCS1    |
|          | QPSK-3/4            | MCS2    |
|          | 16QAM-1/2           | MCS3    |
|          | 16QAM-3/4           | MCS4    |
|          | 64QAM-2/3           | MCS5    |
|          | 64QAM-3/4           | MCS6    |
|          | 64QAM-5/6           | MCS7    |
|          | 256QAM-3/4          | MCS8    |
|          | 256QAM-5/6          | MCS9    |

### Datarates

The following table lists the Tx throughput gains from MIMO:

| VHT MCS index                                | Modulation type | Coding rate | Data rate (Mbps) |           |                |           |                |           |
|----------------------------------------------|-----------------|-------------|------------------|-----------|----------------|-----------|----------------|-----------|
|                                              |                 |             | 20 MHz channel   |           | 40 MHz channel |           | 80 MHz channel |           |
|                                              |                 |             | 800 ns GI        | 400 ns GI | 800 ns GI      | 400 ns GI | 800 ns GI      | 400 ns GI |
| One spacial stream (requires 1 Tx antenna)   |                 |             |                  |           |                |           |                |           |
| 0                                            | BPSK            | 1/2         | 6.5              | 7.2       | 13.5           | 15        | 29.3           | 32.5      |
| 1                                            | QPSK            | 1/2         | 13               | 14.4      | 27             | 30        | 58.5           | 65        |
| 2                                            | QPSK            | 3/4         | 19.5             | 21.7      | 40.5           | 45        | 87.8           | 97.5      |
| 3                                            | 16-QAM          | 1/2         | 26               | 28.9      | 54             | 60        | 117            | 130       |
| 4                                            | 16-QAM          | 3/4         | 39               | 43.3      | 81             | 90        | 175.5          | 195       |
| 5                                            | 64-QAM          | 2/3         | 52               | 57.8      | 108            | 120       | 234            | 260       |
| 6                                            | 64-QAM          | 3/4         | 58.5             | 65        | 121.5          | 135       | 263.3          | 292.5     |
| 7                                            | 64-QAM          | 5/6         | 65               | 72.2      | 135            | 150       | 292.5          | 325       |
| 8                                            | 256-QAM         | 3/4         | 78               | 86.7      | 162            | 180       | 351            | 390       |
| 9                                            | 256-QAM         | 5/6         | -                | -         | 180            | 200       | 390            | 433.3     |
| Two spatial streams (requires 2 Tx antennas) |                 |             |                  |           |                |           |                |           |
| 0                                            | BPSK            | 1/2         | 13               | 14.4      | 27             | 30        | 58.5           | 65        |
| 1                                            | QPSK            | 1/2         | 26               | 28.9      | 54             | 60        | 117            | 130       |
| 2                                            | QPSK            | 3/4         | 39               | 43.3      | 81             | 90        | 175.5          | 195       |
| 3                                            | 16-QAM          | 1/2         | 52               | 57.8      | 108            | 120       | 234            | 260       |
| 4                                            | 16-QAM          | 3/4         | 78               | 86.7      | 162            | 180       | 351            | 390       |
| 5                                            | 64-QAM          | 2/3         | 104              | 115.6     | 216            | 240       | 468            | 520       |
| 6                                            | 64-QAM          | 3/4         | 117              | 130       | 243            | 270       | 526.5          | 585       |
| 7                                            | 64-QAM          | 5/6         | 130              | 144.4     | 270            | 300       | 585            | 650       |
| 8                                            | 256-QAM         | 3/4         | 156              | 173.3     | 324            | 360       | 702            | 780       |
| 9                                            | 256-QAM         | 5/6         | -                | -         | 360            | 400       | 780            | 866.7     |

**RF channels**

The ConnectCore 8X module supports the following frequency bands:

| RF band | Ch. BW | Ch. spacing | Channel number (Center freq. MHz)                                                                                                                                                                                                                                         |
|---------|--------|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2.4 GHz | 20 MHz | 5 MHz       | 1(2412), 2(2417), 3(2422), 4(2427), 5(2432), 6(2437), 7(2442), 8(2447), 9(2452), 10(2457), 11(2462), 12(2467), 13(2472), 14(2484)                                                                                                                                         |
|         | 40 MHz | 5 MHz       | 3(2422), 6(2437), 9(2452)                                                                                                                                                                                                                                                 |
| 5 GHz   | 20 MHz | 20 MHz      | 36(5180), 40(5200), 44(5220), 48(5240), 52(5260), 56(5280), 60(5300), 64(5320), 100(5500), 104(5520), 108(5540), 112(5560), 116(5580), 120(5600), 124(5620), 128(5640), 132(5660), 136(5680), 140(5700), 144(5720), 149(5745), 153(5765), 157(5785), 161(5805), 165(5825) |
|         | 40 MHz | 40 MHz      | 38(5190), 46(5230), 54(5270), 62(5310), 102(5510), 110(5550), 118(5590), 126(5630), 134(5670), 142(5710), 151(5755), 159(5795)                                                                                                                                            |
|         | 80 MHz | 80 MHz      | 42(5210), 58(5290), 106(5530), 122(5610), 138(5690), 155(5775)                                                                                                                                                                                                            |

**Note** Dependent upon regulatory bodies.

#### 2.4 GHz band channels (20 MHz BW)

| Channel # | Center frequency (MHz) | EUROPE (ETSI) | US (FCC) | Canada (ISED) | JAPAN        |
|-----------|------------------------|---------------|----------|---------------|--------------|
| 1         | 2412                   | ✓             | ✓        | ✓             | ✓            |
| 2         | 2417                   | ✓             | ✓        | ✓             | ✓            |
| 3         | 2422                   | ✓             | ✓        | ✓             | ✓            |
| 4         | 2427                   | ✓             | ✓        | ✓             | ✓            |
| 5         | 2432                   | ✓             | ✓        | ✓             | ✓            |
| 6         | 2437                   | ✓             | ✓        | ✓             | ✓            |
| 7         | 2442                   | ✓             | ✓        | ✓             | ✓            |
| 8         | 2447                   | ✓             | ✓        | ✓             | ✓            |
| 9         | 2452                   | ✓             | ✓        | ✓             | ✓            |
| 10        | 2457                   | ✓             | ✓        | ✓             | ✓            |
| 11        | 2462                   | ✓             | ✓        | ✓             | ✓            |
| 12        | 2467                   | ✓             | No       | No            | ✓            |
| 13        | 2472                   | ✓             | No       | No            | ✓            |
| 14        | 2484                   | No            | No       | No            | 802.11b only |

**5 GHz band channels (20 MHz BW)**

| Channel # | Center frequency (MHz) | EUROPE (ETSI)       | US (FCC) | Canada (ISED) | JAPAN     |
|-----------|------------------------|---------------------|----------|---------------|-----------|
| 36        | 5180                   | Indoors             | ✓        | ✓             | ✓         |
| 40        | 5200                   | Indoors             | ✓        | ✓             | ✓         |
| 44        | 5220                   | Indoors             | ✓        | ✓             | ✓         |
| 48        | 5240                   | Indoors             | ✓        | ✓             | ✓         |
| 52        | 5260                   | Indoors / DFS / TPC | DFS      | DFS           | DFS / TPC |
| 56        | 5280                   | Indoors / DFS / TPC | DFS      | DFS           | DFS / TPC |
| 60        | 5300                   | Indoors / DFS / TPC | DFS      | DFS           | DFS / TPC |
| 64        | 5320                   | Indoors / DFS / TPC | DFS      | DFS           | DFS / TPC |
| 100       | 5500                   | DFS / TPC           | DFS      | DFS           | DFS / TPC |
| 104       | 5520                   | DFS / TPC           | DFS      | DFS           | DFS / TPC |
| 108       | 5540                   | DFS / TPC           | DFS      | DFS           | DFS / TPC |
| 112       | 5560                   | DFS / TPC           | DFS      | DFS           | DFS / TPC |
| 116       | 5580                   | DFS / TPC           | DFS      | DFS           | DFS / TPC |
| 120       | 5600                   | DFS / TPC           | DFS      | No Access     | DFS / TPC |
| 124       | 5620                   | DFS / TPC           | DFS      | No Access     | DFS / TPC |
| 128       | 5640                   | DFS / TPC           | DFS      | No Access     | DFS / TPC |
| 132       | 5660                   | DFS / TPC           | DFS      | DFS           | DFS / TPC |
| 136       | 5680                   | DFS / TPC           | DFS      | DFS           | DFS / TPC |
| 140       | 5700                   | DFS / TPC           | DFS      | DFS           | DFS / TPC |
| 144       | 5720                   | No Access           | DFS      | DFS           | DFS / TPC |
| 149       | 5745                   | SRD                 | ✓        | ✓             | No Access |
| 153       | 5765                   | SRD                 | ✓        | ✓             | No Access |
| 157       | 5785                   | SRD                 | ✓        | ✓             | No Access |

| Channel # | Center frequency (MHz) | EUROPE (ETSI) | US (FCC) | Canada (ISED) | JAPAN     |
|-----------|------------------------|---------------|----------|---------------|-----------|
| 161       | 5805                   | SRD           | ✓        | ✓             | No Access |
| 165       | 5825                   | SRD           | ✓        | ✓             | No Access |

**Note**

DFS = Dynamic Frequency Selection

TPC = Transmit Power Control

SRD = Short Range Devices

See [Regulatory information](#) for further details about available RF channels and their maximum transmit power.

**Receive sensitivity**

The following table lists typical receive sensitivity values for the ConnectCore 8X module.

| Mode       |      | 802.11b |         | 802.11ga |           | 802.11n  |           | 802.11ac |           |            |
|------------|------|---------|---------|----------|-----------|----------|-----------|----------|-----------|------------|
| Modulation |      | DBPSK   | CCK     | BPSK-1/2 | 64QAM-3/4 | BPSK-1/2 | 64QAM-5/6 | BPSK-1/2 | 64QAM-5/6 | 256QAM-5/6 |
|            |      | 1 Mbps  | 11 Mbps | 6 Mbps   | 54 Mbps   | MCS0     | MCS7      | MCS0     | MCS7      | MCS9       |
| 2.4 GHz    | HT20 | -90     | -88     | -90      | -75       | -82      | -64       | -82      | -64       | -          |
|            | HT40 | -       | -       | -        | -         | -79      | -61       | -79      | -61       | -54        |
| 5 GHz      | HT20 | -       | -       | -90      | -75       | -82      | -64       | -82      | -64       | -          |
|            | HT40 | -       | -       | -        | -         | -79      | -61       | -79      | -61       | -54        |
|            | HT80 | -       | -       | -        | -         | -        | -         | -76      | -58       | -51        |

**Note** Specification is subject to change.

### ***Transmit power***

The following tables list the maximum transmit power values for the ConnectCore 8X module. The values corresponds to the power configured for each antenna individually, so in MIMO applications total output power will be the sum of both antennas.

| FCC     |            |          |                    |
|---------|------------|----------|--------------------|
| RF band | Channel BW | Standard | Output power (dBm) |
| 2.4 GHz | 20 MHz     | 802.11b  | 13.5               |
|         | 20 MHz     | 802.11g  | 17                 |
|         | 20 MHz     | 802.11n  | 18                 |
|         | 40 MHz     | 802.11n  | 12                 |
| 5 GHz   | 20 MHz     | 802.11a  | 13                 |
|         | 20 MHz     | 802.11n  | 12                 |
|         | 20 MHz     | 802.11ac | 12                 |
|         | 40 MHz     | 802.11n  | 12                 |
|         | 40 MHz     | 802.11ac | 12                 |
|         | 80 MHz     | 802.11ac | 11                 |

| CE      |            |          |                    |
|---------|------------|----------|--------------------|
| RF band | Channel BW | Standard | Output power (dBm) |
| 2.4 GHz | 20 MHz     | 802.11b  | 9                  |
|         | 20 MHz     | 802.11g  | 10                 |
|         | 20 MHz     | 802.11n  | 10.5               |
|         | 40 MHz     | 802.11n  | 10                 |
| 5 GHz   | 20 MHz     | 802.11a  | 13                 |
|         | 20 MHz     | 802.11n  | 12                 |
|         | 20 MHz     | 802.11ac | 12                 |
|         | 40 MHz     | 802.11n  | 12                 |
|         | 40 MHz     | 802.11ac | 12                 |
|         | 80 MHz     | 802.11ac | 11                 |

| TELEC   |            |          |                    |
|---------|------------|----------|--------------------|
| RF band | Channel BW | Standard | Output power (dBm) |
| 2.4 Gz  | 20 MHz     | 802.11b  | 10.5               |
|         | 20 MHz     | 802.11g  | 15                 |
|         | 20 MHz     | 802.11n  | 15.5               |
|         | 40 MHz     | 802.11n  | 15                 |
| 5 GHz   | 20 MHz     | 802.11a  | 13                 |
|         | 20 MHz     | 802.11n  | 12                 |
|         | 20 MHz     | 802.11ac | 12                 |
|         | 40 MHz     | 802.11n  | 12                 |
|         | 40 MHz     | 802.11ac | 12                 |
|         | 80 MHz     | 802.11ac | 11                 |

**Note** The tables list the maximum output power for each standard, regulatory domain and bandwidth channel. Output power may be lower depending on the channel and modulation.

See [Regulatory information](#) for further details about available RF channels and their maximum transmit power.

## Bluetooth

The ConnectCore 8X module supports both Bluetooth and Bluetooth Low Energy protocols:

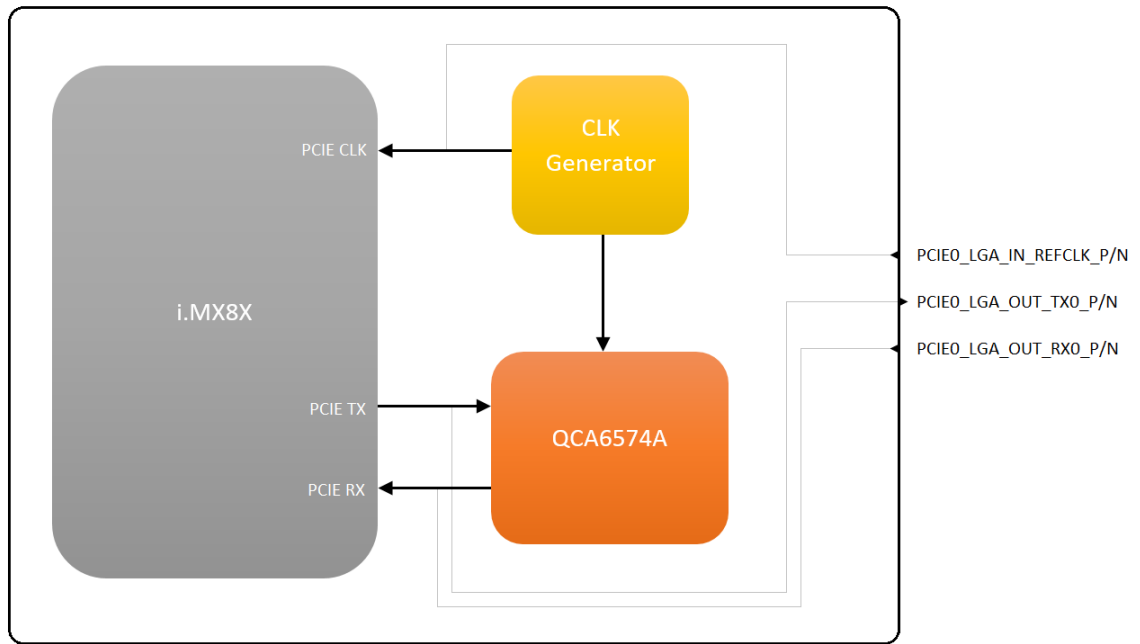
- Bluetooth 5.0; backwards compatible with Bluetooth 1.X, 2.X + Enhanced Data Rate, Bluetooth 3.X, Bluetooth 4.X, and Bluetooth class 1 and class 2 power-level transmissions
- Integrated WLAN-Bluetooth coexistence

See [Bluetooth certification](#) for more information.

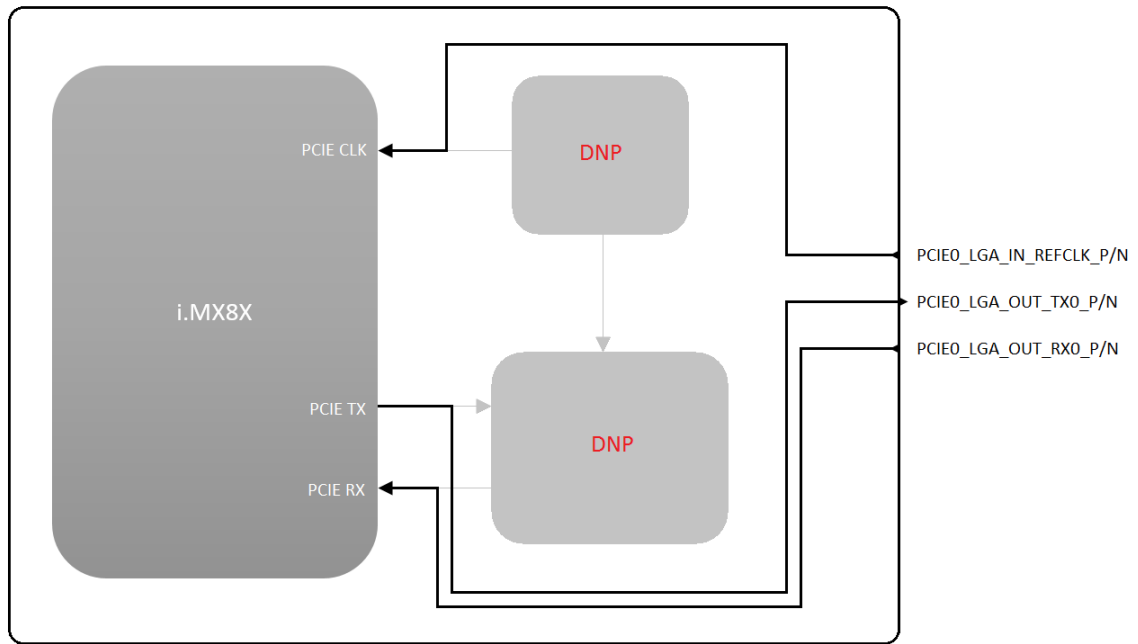
## PCI Express

The ConnectCore 8X module features one PCI Express dual mode (DM) controller. This interface is not externally available in wireless variants of the SOM, since it is used by the wireless MAC. In non-wireless variants, it can be used externally. The following diagrams show the internal PCIe configuration:

## Wireless variants



## Non-wireless variants



The dedicated PCIe clock generator is not internally populated in the non-wireless variants, so to use the PCI Express interface it must be populated externally (see the [ConnectCore 8X SBC Pro reference design](#)).

The following control lines can also be used externally in non-wireless variants:

- PCIE\_LGA\_OUT\_CTRL0\_WAKE\_B
- PCIE\_LGA\_OUT\_CTRL0\_CLKREQ\_B
- PCIE\_LGA\_OUT\_CTRL0\_PERST\_B

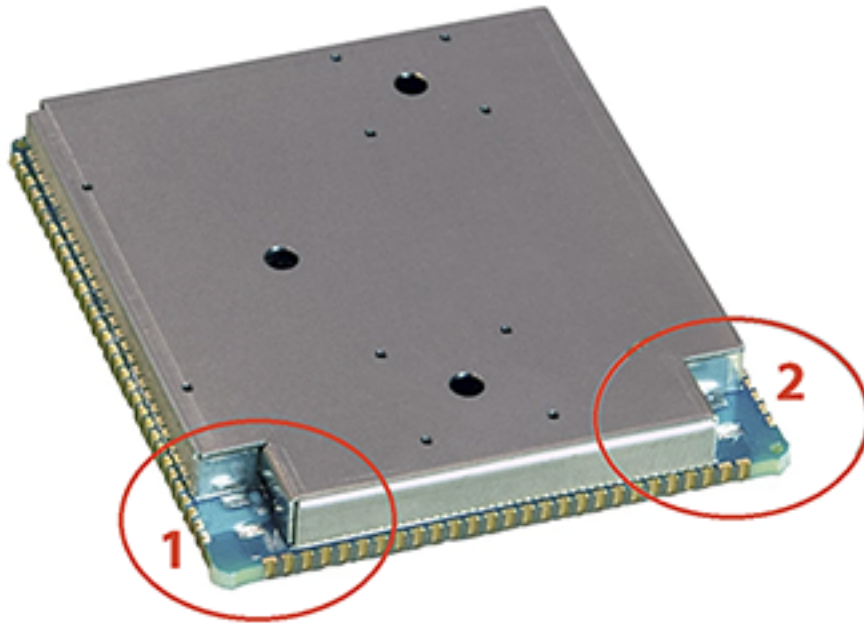
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**Note** There are other PCIe-related pads on the ConnectCore 8X module: F7, F8, F9, G20, G21, G23, G24. Leave these pins unconnected.

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## Antenna ports

The ConnectCore 8X module has two antenna ports:



Antenna 1 supports both WLAN 2.4&5GHz and Bluetooth, and antenna 2 only supports WLAN 2.4&5GHz.

## CryptoAuthentication device

The ConnectCore 8X module includes an Atmel CryptoAuthentication Device. This is a highly secure cryptographic co-processor with secure hardware-based key storage. It includes the following features:

- Performs high-speed public key (PKI) algorithms (ECDSA and ECDH). NIST standard P256 elliptic curve support.
- SHA-256 hash algorithm with HMAC option.
- 256-bit key length.
- Storage for up to 16 keys.
- Two high-endurance monotonic counters.
- Guaranteed unique 72-bit serial number.
- Internal High-quality FIPS Random Number Generator (RNG).
- 10 Kb EEPROM memory.

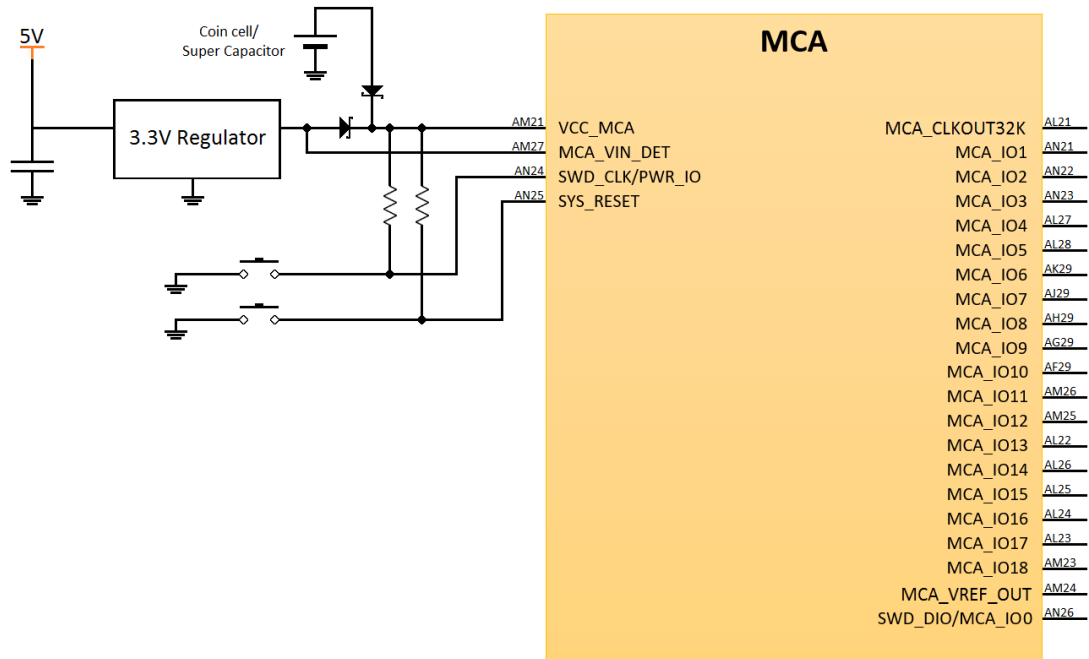
See the [software documentation](#) for information about supported cryptoauthentication features.

## The Digi Microcontroller Assist™ hardware

The Digi Microcontroller Assist, or MCA, is a small microcontroller that is deeply integrated into the design of the ConnectCore 8X module. It assists the i.MX 8X processor with advanced operations related to power management, security, and system reliability. The functionality provided by the MCA includes:

- Advanced power management such as power key button, wake up sources, and PMIC control in low power.
- Peripheral extensions such as RTC, watchdog, and tamper pins.

The MCA and the i.MX 8X are connected through an I2C interface and an interrupt line. The microcontroller provides up to 19 general purpose IOs that can be configured with different modes to provide functionality such as digital input/output or ADC.



## Reset control

The MCA, in cooperation with the PMIC, controls the reset line of the i.MX 8X processor. The SYS\_RESET pin is the main reset input of the ConnectCore 8X module. This pin is a pseudo open-drain with an internal pull up. Asserting the SYS\_RESET line low sets the MCA into reset state, and it remains in this state until the line is de-asserted.

During system initialization, the MCA performs the following actions:

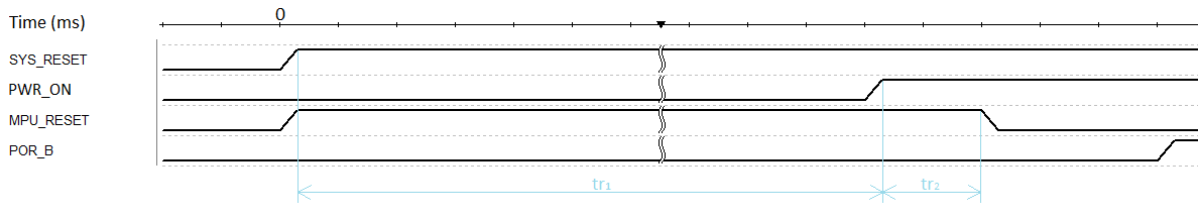
- Asserts the PMIC on/off line (SCU\_PMIC\_ON\_REQ) low for a configurable time (0-255 ms with a default value of 50ms). This powers the PMIC off, switching off all regulated outputs of the PMIC. You can disable this power cycle by setting the timer to 0.
- Asserts the PMIC on/off line high to power the system on.
- Keeps the reset line of the CPU low for a configurable time.

- Releases the reset line of the CPU to allow starting the execution of the firmware on the i.MX 8X processor.

**Note** The CPU reset line is also connected to the PMIC. The PMIC won't release this line until it is switched on and the entire starting sequence is finished (a few ms after the latest regulator is turned on). This means that even if the MCA releases the reset line before the PMIC is ready, the CPU won't go out of reset.

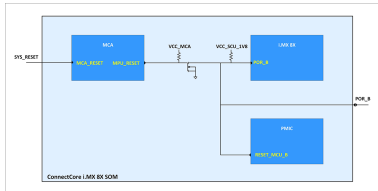
The following time diagram represents the reset sequence. Default values are as follows:

- $tr_1$ : 50 ms
- $tr_2$ : 2 ms



See [System power-up sequence](#) for more information about the power-up sequence of the ConnectCore 8X.

### Reset line internal connection



## IOs

The ConnectCore 8X MCA provides up to 19 configurable IOs.

Because the general purpose IOs do not incorporate internal pull-ups or pull-downs, you may have to add the components to the module carrier board.

The following table lists all available MCA IOs with their configurable capabilities:

| MCA IO          | Pad LGA / castellated pads | Digital I/O | IRQ capable | ADC | 32KHz clock | 1.2 Vref |
|-----------------|----------------------------|-------------|-------------|-----|-------------|----------|
| MCA_VREF_OUT    | AM24                       | ✓           | ✓           | ✓   |             | ✓        |
| MCA_CLKOUT32K   | AL21                       |             |             |     | ✓           |          |
| SWD_DIO/MCA_IO0 | AN26 / 57                  | ✓           | ✓           |     |             |          |

| MCA IO   | Pad LGA / castellated pads | Digital I/O | IRQ capable | ADC | 32KHz clock | 1.2 Vref |
|----------|----------------------------|-------------|-------------|-----|-------------|----------|
| MCA_IO1  | AN21 / 52                  | ✓           | ✓           | ✓   |             |          |
| MCA_IO2  | AN22 / 53                  | ✓           | ✓           | ✓   |             |          |
| MCA_IO3  | AN23 / 54                  | ✓           | ✓           | ✓   |             |          |
| MCA_IO4  | AL27 / 61                  | ✓           | ✓           | ✓   |             |          |
| MCA_IO5  | AL28 / 62                  | ✓           | ✓           | ✓   |             |          |
| MCA_IO6  | AK29 / 63                  | ✓           | ✓           | ✓   |             |          |
| MCA_IO7  | AJ29 / 64                  | ✓           | ✓           | ✓   |             |          |
| MCA_IO8  | AH29 / 65                  | ✓           | ✓           | ✓   |             |          |
| MCA_IO9  | AG29 / 66                  | ✓           | ✓           |     |             |          |
| MCA_IO10 | AF29 / 67                  | ✓           | ✓           |     |             |          |
| MCA_IO11 | AM26                       | ✓           | ✓           | ✓   |             |          |
| MCA_IO12 | AM25                       | ✓           | ✓           | ✓   |             |          |
| MCA_IO13 | AL22                       | ✓           | ✓           |     |             |          |
| MCA_IO14 | AL26                       | ✓           | ✓           | ✓   |             |          |
| MCA_IO15 | AL25                       | ✓           | ✓           |     |             |          |
| MCA_IO16 | AL24                       | ✓           | ✓           |     |             |          |
| MCA_IO17 | AL23                       | ✓           | ✓           |     |             |          |
| MCA_IO18 | AM23                       | ✓           | ✓           | ✓   |             |          |

### Digital IOs

All MCA IOs can be configured as digital inputs/outputs, which are powered from the VCC\_MCA power rail.

The digital outputs preserve the output value set in all operating modes, except in power off and coin cell modes where the IOs are reconfigured to high impedance state to preserve power.

### MCA IRQs

You can configure the MCA IOs as interrupt inputs, using the MCA software to configure the active edge of the interrupt (rising, falling, or both). The firmware provides a configurable debounce filter for each GPIO that improves noise immunity and filters rebounds on push buttons. When one or more MCA IRQs are activated, the MCA interrupts the main processor through the corresponding IRQ line, signaling the active IRQs in the IRQ status registers. The IRQ inputs can wake the system from any low power mode (suspend or power off).

See the [MCA software documentation](#) for additional information about how to configure and access the MCA IRQ lines.

## Analog to digital converter

Many of the MCA IOs can be configured as Analog to digital channels. The index of the MCA ADC channels corresponds to the index of the MCA IO. This means that ADC channel 1 corresponds to the MCA\_IO1, ADC channel 2 to the MCA\_IO2, and so on.

The result of the ADC conversion for a given input voltage is inversely proportional to the reference voltage of the ADC. For the MCA ADCs, the reference voltage corresponds to the VCC\_MCA voltage. (Note that the i.MX 8X ADCs have a different reference voltage.) The MCA ADC provides 12-bit of resolution with right-justified, unsigned format output. These ADCs are suitable for low-frequency sampling (under 10 Hz). For higher frequency sampling, Digi recommends the CPU ADC channels. You can configure the MCA ADC lines to act as an analog window comparator and generate an IRQ depending on the voltage level in the input. This feature allows applications to be notified of this event instead of needing to periodically poll the input for its value.

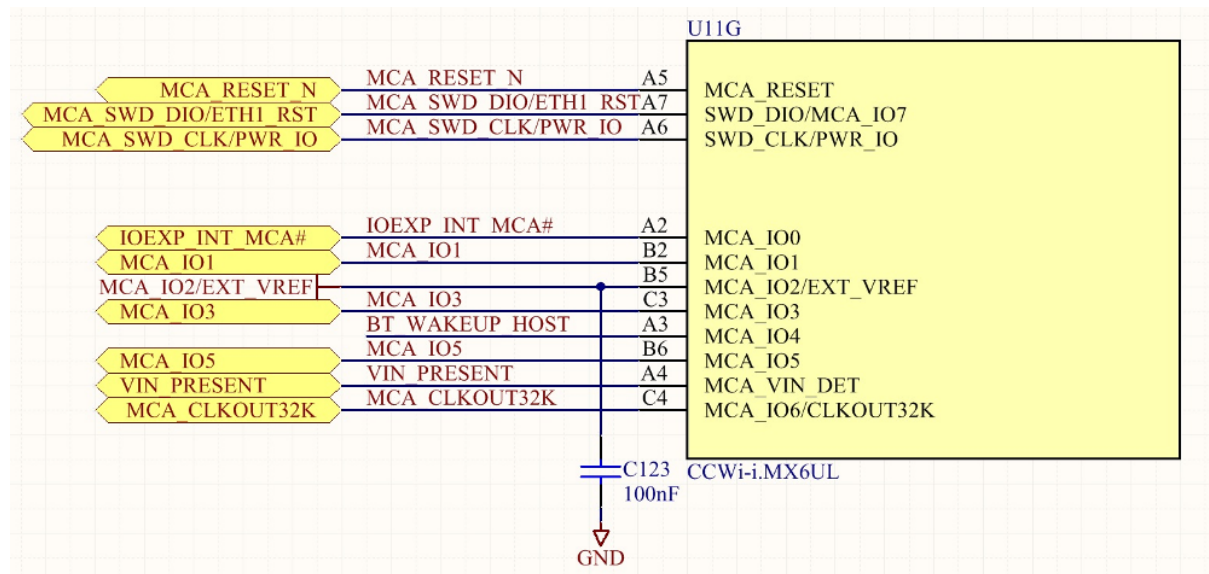
See the [MCA software documentation](#) for additional information about how to configure and access the MCA IRQ lines.

## External voltage reference

The MCA\_VREF\_OUT pin provides an accurate voltage reference of 1.2V that can be used to provide a reference voltage for sensors and/or analog devices (such as comparators or ADCs).

The MCA\_VREF\_OUT pin is disabled by default. You must use software to configure the pin for external voltage reference.

See the [MCA software documentation](#) for additional information about how to control the function of this pin.



Note that the voltage reference continues normal operation in low power modes (suspend and power off). Therefore, if the voltage reference is enabled during normal operation but is not required for low power operation, Digi recommends using the software to disable it before entering low power in order to minimize the power consumption, and re-enable it when resuming normal operation.

## External 32KHz clock output

The MCA\_CLKOUT32K pin is a 32.768 Hz square wave output that can be used as clock input by peripherals requiring a low-frequency, high-accuracy clock.

---

**Note** The 32KHz clock output continues normal operation in low power modes (suspend and power off). Therefore, if the 32KHz clock output is enabled during normal operation but is not required for low power operation, Digi recommends using the software to disable it before entering low power in order to minimize power consumption, and re-enable it when resuming normal operation.

---

## Watchdog

The MCA implements a watchdog timer in its firmware. The MCA watchdog resets the system, or only the i.MX 8X CPU, if the software running on the main processor fails to execute properly and does not reset the watchdog timer on time.

The main features of the MCA watchdog include:

- Configurable timeout between 1 and 255 seconds.
- Configurable to generate interrupt or system reset.
- Configurable to generate full-system reset (including the MCA itself) or CPU-only reset. Full-system reset can include a PMIC off/on, depending on the device configuration.

See the [MCA software documentation](#) for additional information about how to configure and access the watchdog timer.

## Real-time clock

The MCA implements a Real-Time Clock (RTC) in its firmware. The i.MX 8X CPU internal RTCs are disabled by default because the MCA RTC is preferred due to its superior power consumption efficiency. To preserve the date during power-off, you must connect a coin cell battery following the design notes provided in [System-on-module power rails distribution](#).

The main features of the MCA RTC include:

- Date/time registers to keep the system time (backed up by the coin cell battery).
- Programmable alarm to generate an interrupt. This alarm can be used to wake the system from low power modes (suspend and power off).

See the [MCA software documentation](#) for additional information about how to configure and access the watchdog timer.

## Pulse width modulation

Pulse-width modulation (PWM) is a technique that modifies the duty cycle of a pulsing signal to encode information or to control the amount of energy provided to a charge. The MCA implements pulse-width modulation in its firmware.

The MCA on the ConnectCore 8X system-on-module provides three PWM controllers. Each controller has several channels and each channel maps to one MCA IO pin:

| PWM controller | Number of channels | Channel | IO       |
|----------------|--------------------|---------|----------|
| PWM0           | 6                  | 0       | MCA_IO0  |
|                |                    | 1       | MCA_IO12 |
|                |                    | 2       | MCA_IO15 |
|                |                    | 3       | MCA_IO16 |
|                |                    | 4       | MCA_IO17 |
|                |                    | 5       | MCA_IO18 |
| PWM1           | 2                  | 0       | MCA_IO5  |
|                |                    | 1       | MCA_IO6  |
| PWM2           | 2                  | 0       | MCA_IO7  |
|                |                    | 1       | MCA_IO8  |

On the ConnectCore 8X:

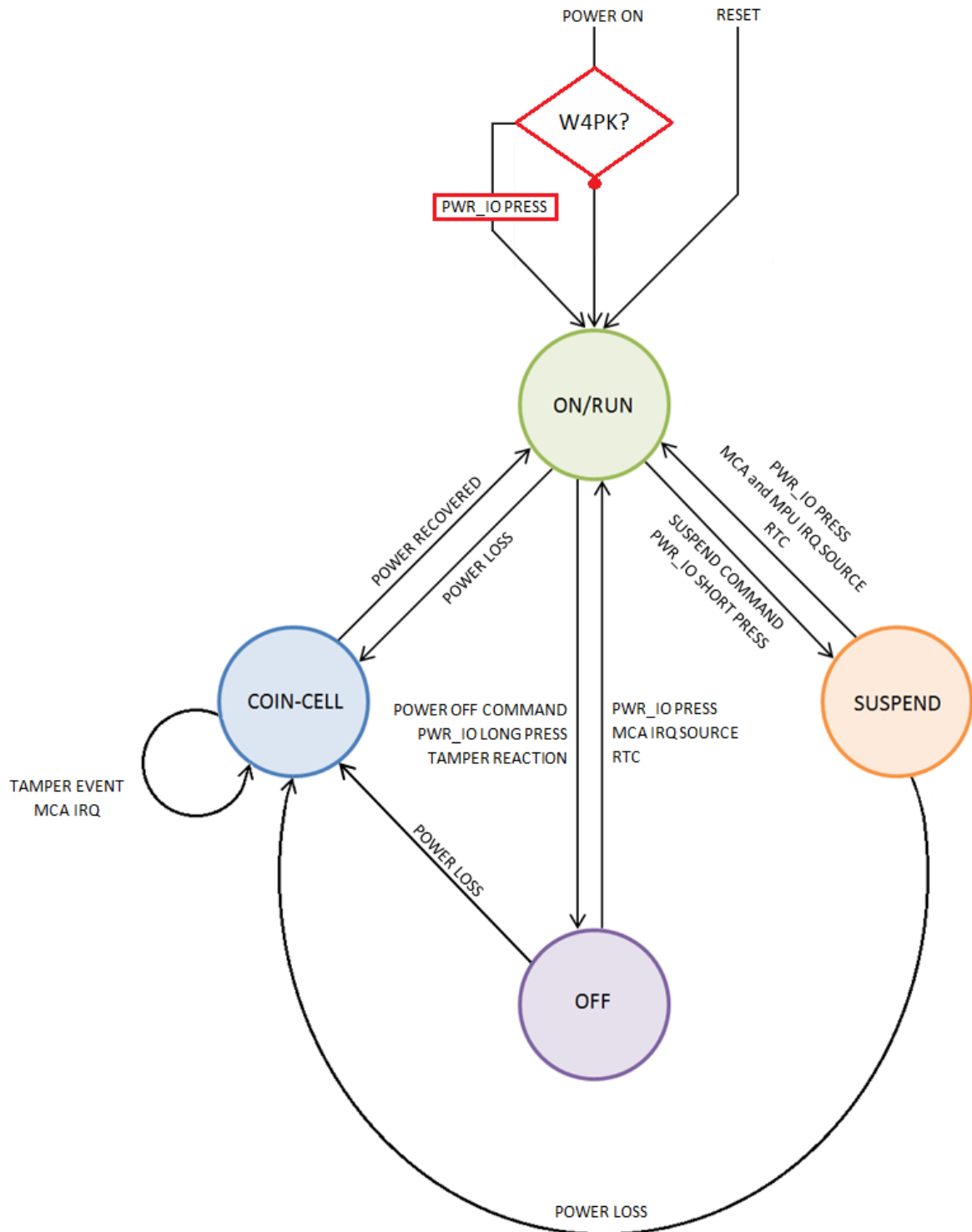
- All MCA PWM channels are available on the LGA pads.
- PWM0 channel 0 is available on the castellated pads.
- PWM1 channels 0 and 1 are available on the castellated pads.
- PWM2 channels 0 and 1 are available on the castellated pads.

## Power management

The MCA plays a key role in the power management activities of the ConnectCore 8X module. In cooperation with the i.MX 8X processor, the MCA controls the power states of the PMIC and provides multiple wake up sources to transition between power modes. It also allocates dedicated signals to capture power events and indicate the system power state, allowing you to control external power sources and indicators.

### ***Power modes***

The module provides four different power operating modes: ON/RUN, OFF, SUSPEND, and COIN-CELL. The following figure shows the state diagram and the events to switch between states.



### W4PK mode

You can configure boot mode using the **mca\_config\_tool -boot\_mode** option.

If 'boot on power' (BOP) is chosen, the module will enter in ON state as soon as power is applied.

If ‘wait for power key’ (W4PK) is chosen, the module will wait for a PWR\_IO press before entering in ON state when power is applied.

### **ON/RUN mode**

In this mode, the PMIC is running at full power so all voltage regulators are generating the nominal voltage for this mode. The CPU reset line is de-asserted and the processor is running at normal speed, performing DVFS if the system was configured to do so. In this state, the SCU\_PMIC\_ON\_REQ line is asserted high, indicating that the module is ON.

Note that the specific state of the regulators (on/off) and the voltage in this mode are controlled by the firmware running on the i.MX 8X processor. The PMIC starts with the default settings configured on the OTP area, but once the software takes control it applies the specific configuration implemented in the firmware.

### **SUSPEND mode**

The suspend mode (also known as suspend-to-RAM mode) is the low-power mode that allows the module to preserve RAM content. When the module enters SUSPEND, the following actions take place:

- The processor goes into low power, disabling as much functionality as possible and keeping active only the peripherals configured to wake the system from SUSPEND.
- The DDR memory is set to self-refresh mode to preserve its contents while reducing power consumption.
- The PMIC goes into standby mode, configuring the regulators for this specific mode.
- The MCA goes into sleep mode, keeping active the peripherals that always run in low power modes (like the RTC) and those configured to wake up the system (such as IRQs and power IO). MCA GPIOs configured as outputs also keep their value.

### **OFF mode**

The module enters OFF mode after a power-off event. In this mode:

- The PMIC is set to the OFF state and all the voltage regulators, except VSNVS, are switched off.
- The SCU\_PMIC\_ON\_REQ line is asserted low, indicating that the module is in OFF state.
- The MCA goes into sleep mode, keeping active the peripherals that always run in low-power modes (like the RTC) and those configured to wake up the system (such as IRQs and power IO).

### **COIN-CELL mode**

In COIN-CELL mode, only the MCA is powered from the coin-cell battery, leaving the rest of the module power inputs switched off. In this mode, the MCA remains in sleep mode, updating the RTC and monitoring the following events:

- Tamper events that would be registered in the NVRAM memory of the MCA and would assert the Tamper output if enabled.
- Power in MCA\_VIN\_DET, which indicates that power is reconnected to the system and it can be powered-on.

### **Power IO signal/Power button**

The MCA provides a signal (PWR\_IO) to detect external events that trigger a transition between the different power modes described in [Power modes](#). The pin has wake-up interrupt/event capabilities, it is active low, and it does not provide an internal pull-up. (The pull-up resistor, typically a 100K resistor to VCC\_MCA, must be added externally.) This signal is ideal for connecting a power button or the output of a peripheral that controls the power state of the module and its transitions. The firmware

provides a configurable debounce filter to improve noise immunity and filter rebounds on push buttons. When the PWR\_IO signal is asserted low, one of the following events occurs:

- If the duration of the assertion is short (time configurable by the user) the system will trigger an interrupt that, commonly, indicates the host processor that the system should enter suspend state. When the system is in a low-power mode, the effect of a short assertion of this line is the following:
  - While in suspend state, it will wake the system.
  - While in OFF state, it will boot the system.
- If the low-pulse duration is long enough (again, time-configurable by the user) the system triggers the power off interrupt, to tell the host processor to start a transition to OFF state.
- If the system does not enter OFF state before a configurable guard timer expires, the MCA will automatically set the OFF state unless the user explicitly cancels it by writing to the **mca\_cancel\_pwroff** entry in the sysfilesystem.

### ***MCA\_VIN\_DET signal***

The on-module MCA is powered from a dedicated external power rail, VCC\_MCA. As recommended in the reference designs (see [System-on-module power rails distribution](#)), this power supply is provided by an external 3.3V regulator. If the system requires system time to be kept when there is no power, you must use a coin-cell battery to power the MCA while it keeps the RTC up to date in low-power mode. The MCA uses the MCA\_VIN\_DET input to monitor the input voltage of the whole system and automatically switch to RTC mode when it is disconnected, to keep the system time and save power.

MCA\_VIN\_DET is a digital line, not analog. This means that the transition time between high and low values is crucial to optimize the time the system takes to switch to RTC mode. Digi recommends you ensure a fast discharge of this signal to allow a quick fall time.

### **MCA firmware update**

The i.MX 8X processor can update the firmware of the MCA. See the [MCA software documentation](#) for additional information about the MCA firmware update process.

# IOMUX

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The following sections describe the pin multiplexing (IOMUX) of the ConnectCore 8X

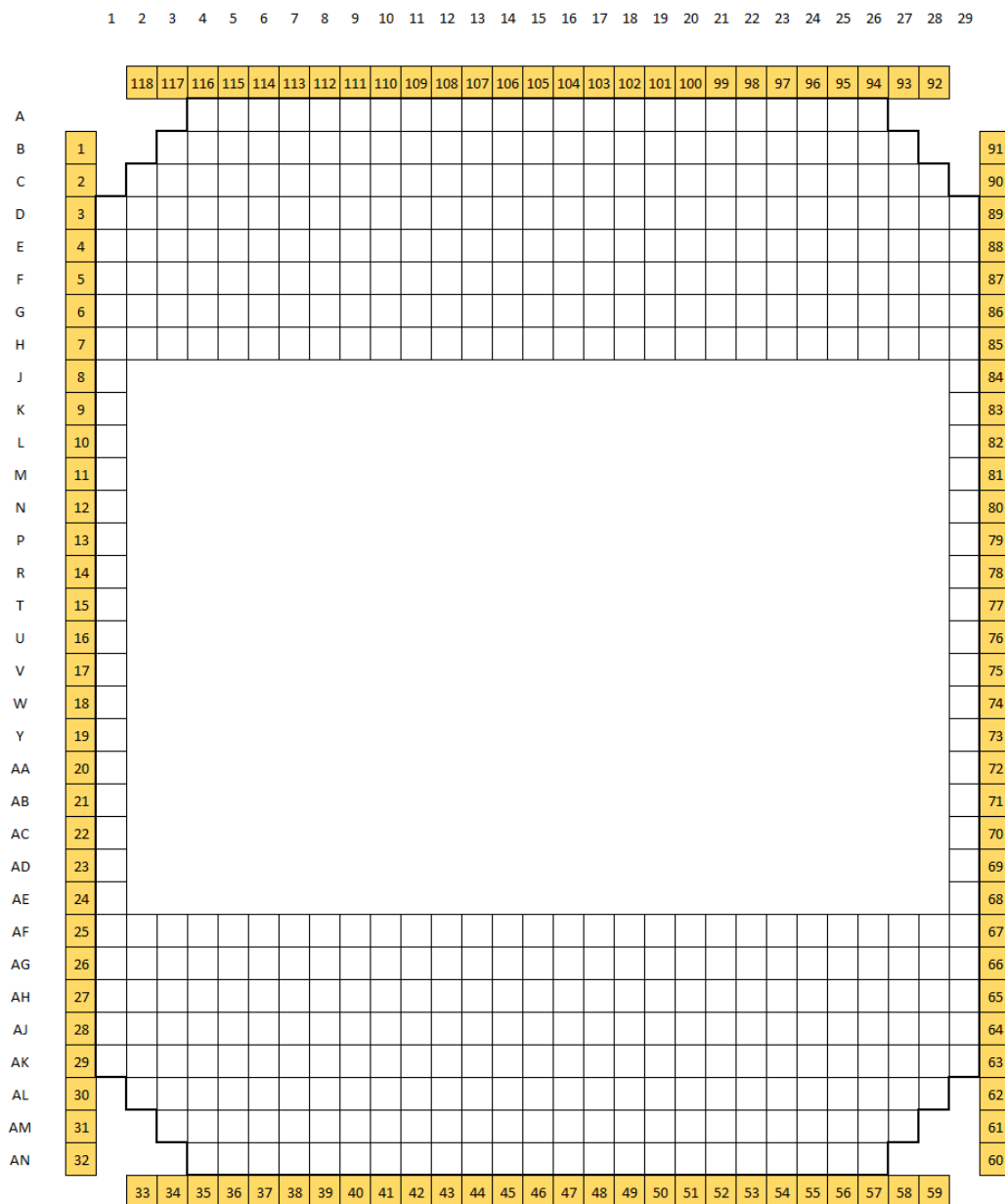
**Note** The Digi ConnectCore Smart IOmux tool can dramatically simplify pin configuration and resolution. You can enter the list of interfaces required by your project and use the Smart IOmux graphical interface to mock up configuration options, resulting in full pin assignment and device tree snippets that match your desired functionality. See the [Smart IOmux User Guide](#) for more information and download instructions.

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|                            |    |
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| IOMUX table .....          | 43 |
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## Module pinout

The ConnectCore 8X System-on-module has a mixed pad structure. It provides 474 LGA pads and 118 peripheral castellated pads. The general layout can be found on the following diagram:



**Note** This diagram represents the module as seen from the top side with antennas on top.

IOMUX table

The following table lists the I/O multiplexing (IOMUX) of the ConnectCore 8X System-on-module. Most of the castellated pads are associated with (connected to) an LGA pad; this relationship is highlighted in the "Associated LGA Pad name" column.

The microprocessor used on this module, like all CMOS devices, can be driven into a latch-up condition if any I/O pin is driven outside of its associated power rail. Care must be taken to:



- Never drive an I/O pin beyond its positive rail or below ground.
- Never drive an I/O pin from an external power source during the power-on or reset sequences.
- Never hot-swap the module or interrupt its ground connection to external circuitry.

Latch-up is a condition that can cause excessive current draw and result in excessive heating of the microprocessor or its power supplies. This excessive heating can permanently damage the microprocessor and/or its supporting components.

| Castellated pad # | Associated LGA Pad name | ConnectCore 8X signal name | i.MX 8X pin name* | Multiplexing                                                                                     | Power group | Comments |
|-------------------|-------------------------|----------------------------|-------------------|--------------------------------------------------------------------------------------------------|-------------|----------|
| 1                 | E4                      | USDHC1_RESET_B             | USDHC1_RESET_B    | ALT0: USDHC1_RESET_B<br>ALT1: NAND_RE_N<br>ALT2: SPI2_SCK<br>ALT3:<br>ALT4: GPIO4_IO19           | VDD_USDHC1  |          |
| 2                 | E3                      | USDHC1_VSELECT             | USDHC1_VSELECT    | ALT0: USDHC1_VSELECT<br>ALT1: NAND_RE_P<br>ALT2: SPI2_SDO<br>ALT3: NAND_RE_B<br>ALT4: GPIO4_IO20 | VDD_USDHC1  |          |

| Castellated pad # | Associated LGA Pad name | ConnectCore 8X signal name | i.MX 8X pin name* | Multiplexing                                                                                                                     | Power group | Comments |
|-------------------|-------------------------|----------------------------|-------------------|----------------------------------------------------------------------------------------------------------------------------------|-------------|----------|
| 3                 | F3                      | USDHC1_WP                  | USDHC1_WP         | <b>ALT0:</b> USDHC1_WP<br><b>ALT1:</b> NAND_DQS_N<br><b>ALT2:</b> SPI2_SDI<br><b>ALT3:</b><br><b>ALT4:</b> GPIO4_IO21            | VDD_USDHC1  |          |
| 4                 | G2                      | USDHC1_CD_B                | USDHC1_CD_B       | <b>ALT0:</b> USDHC1_CD_B<br><b>ALT1:</b> NAND_DQS_P<br><b>ALT2:</b> SPI2_CS0<br><b>ALT3:</b> NAND_DQS<br><b>ALT4:</b> GPIO4_IO22 | VDD_USDHC1  |          |
| 5                 | F1                      | USDHC1_CMD                 | USDHC1_CMD        | <b>ALT0:</b> USDHC1_CMD<br><b>ALT1:</b> NAND_CE0_B<br><b>ALT2:</b> MQS_R<br><b>ALT3:</b><br><b>ALT4:</b> GPIO4_IO24              | VDD_USDHC1  |          |
| 6                 | G1                      | USDHC1_DATA0               | USDHC1_DATA0      | <b>ALT0:</b> USDHC1_DATA0<br><b>ALT1:</b> NAND_CE1_B<br><b>ALT2:</b> MQS_L<br><b>ALT3:</b><br><b>ALT4:</b> GPIO4_IO25            | VDD_USDHC1  |          |
| 7                 | H1                      | USDHC1_DATA1               | USDHC1_DATA1      | <b>ALT0:</b> USDHC1_DATA1<br><b>ALT1:</b> NAND_RE_B<br><b>ALT2:</b> UART3_TX<br><b>ALT3:</b><br><b>ALT4:</b> GPIO4_IO26          | VDD_USDHC1  |          |
| 8                 | J1                      | USDHC1_DATA2               | USDHC1_DATA2      | <b>ALT0:</b> USDHC1_DATA2<br><b>ALT1:</b> NAND_WE_B<br><b>ALT2:</b> UART3_CTS_B<br><b>ALT3:</b><br><b>ALT4:</b> GPIO4_IO27       | VDD_USDHC1  |          |

| Castellated pad # | Associated LGA Pad name | ConnectCore 8X signal name | i.MX 8X pin name* | Multiplexing                                                                                                              | Power group      | Comments |
|-------------------|-------------------------|----------------------------|-------------------|---------------------------------------------------------------------------------------------------------------------------|------------------|----------|
| 9                 | K1                      | USDHC1_DATA3               | USDHC1_DATA3      | <b>ALT0:</b> USDHC1_DATA3<br><b>ALT1:</b> NAND_ALE<br><b>ALT2:</b> UART3_RTS_B<br><b>ALT3:</b><br><b>ALT4:</b> GPIO4_IO28 | VDD_USDHC1       |          |
| 10                | L1                      | USDHC1_CLK                 | USDHC1_CLK        | <b>ALT0:</b> USDHC1_CLK<br><b>ALT1:</b><br><b>ALT2:</b> UART3_RX<br><b>ALT3:</b><br><b>ALT4:</b> GPIO4_IO23               | VDD_USDHC1       |          |
| 11                | M1                      | GND                        | -                 | -                                                                                                                         | -                |          |
| 12                | N1                      | VDD_USDHC1                 | -                 | -                                                                                                                         | VDD_USDHC1       |          |
| 13                | P1                      | UART0_TX                   | UART0_TX          | <b>ALT0:</b> UART0_TX<br><b>ALT1:</b> MQS_L<br><b>ALT2:</b> FLEXCAN0_TX<br><b>ALT3:</b><br><b>ALT4:</b> GPIO1_IO22        | 3V3              |          |
| 14                | R1                      | UART0_RX                   | UART0_RX          | <b>ALT0:</b> UART0_RX<br><b>ALT1:</b> MQS_R<br><b>ALT2:</b> FLEXCAN0_RX<br><b>ALT3:</b><br><b>ALT4:</b> GPIO1_IO21        | 3V3              |          |
| 15                | T1                      | GND                        | -                 | -                                                                                                                         | -                |          |
| 16                | U1                      | VDD_MIPI_DSI_DIG           | -                 | -                                                                                                                         | VDD_MIPI_DSI_DIG |          |

| Castellated pad # | Associated LGA Pad name | ConnectCore 8X signal name | i.MX 8X pin name*  | Multiplexing                                                                                                                             | Power group      | Comments |
|-------------------|-------------------------|----------------------------|--------------------|------------------------------------------------------------------------------------------------------------------------------------------|------------------|----------|
| 17                | V1                      | MIPI_DSI0_I2C0_SCL         | MIPI_DSI0_I2C0_SCL | <b>ALT0:</b> MIPI_DSI0_I2C0_SCL<br><b>ALT1:</b> MIPI_DSI1_GPIO0_IO02<br><b>ALT2:</b><br><b>ALT3:</b><br><b>ALT4:</b> GPIO1_IO25          | VDD_MIPI_DSI_DIG |          |
| 18                | W1                      | MIPI_DSI0_I2C0_SDA         | MIPI_DSI0_I2C0_SDA | <b>ALT0:</b> MIPI_DSI0_I2C0_SDA<br><b>ALT1:</b> MIPI_DSI1_GPIO0_IO03<br><b>ALT2:</b><br><b>ALT3:</b><br><b>ALT4:</b> GPIO1_IO26          | VDD_MIPI_DSI_DIG |          |
| 19                | Y1                      | MIPI_DSI0_GPIO0_00         | MIPI_DSI0_GPIO0_00 | <b>ALT0:</b> MIPI_DSI0_GPIO0_IO00<br><b>ALT1:</b> I2C1_SCL<br><b>ALT2:</b> MIPI_DSI0_PWM0_OUT<br><b>ALT3:</b><br><b>ALT4:</b> GPIO1_IO27 | VDD_MIPI_DSI_DIG |          |
| 20                | AA1                     | MIPI_DSI0_GPIO0_01         | MIPI_DSI0_GPIO0_01 | <b>ALT0:</b> MIPI_DSI0_GPIO0_IO01<br><b>ALT1:</b> I2C1_SDA<br><b>ALT2:</b><br><b>ALT3:</b><br><b>ALT4:</b> GPIO1_IO28                    | VDD_MIPI_DSI_DIG |          |
| 21                | AB1                     | MIPI_DSI1_I2C0_SCL         | MIPI_DSI1_I2C0_SCL | <b>ALT0:</b> MIPI_DSI1_I2C0_SCL<br><b>ALT1:</b> MIPI_DSI0_GPIO0_IO02<br><b>ALT2:</b><br><b>ALT3:</b><br><b>ALT4:</b> GPIO1_IO29          | VDD_MIPI_DSI_DIG |          |
| 22                | AC1                     | MIPI_DSI1_I2C0_SDA         | MIPI_DSI1_I2C0_SDA | <b>ALT0:</b> MIPI_DSI1_I2C0_SDA<br><b>ALT1:</b> MIPI_DSI0_GPIO0_IO03<br><b>ALT2:</b><br><b>ALT3:</b><br><b>ALT4:</b> GPIO1_IO30          | VDD_MIPI_DSI_DIG |          |

| Castellated pad # | Associated LGA Pad name | ConnectCore 8X signal name | i.MX 8X pin name*  | Multiplexing                                                                                                                             | Power group      | Comments |
|-------------------|-------------------------|----------------------------|--------------------|------------------------------------------------------------------------------------------------------------------------------------------|------------------|----------|
| 23                | AD1                     | MIPI_DSI1_GPIO0_00         | MIPI_DSI1_GPIO0_00 | <b>ALT0:</b> MIPI_DSI1_GPIO0_IO00<br><b>ALT1:</b> I2C2_SCL<br><b>ALT2:</b> MIPI_DSI1_PWM0_OUT<br><b>ALT3:</b><br><b>ALT4:</b> GPIO1_IO31 | VDD_MIPI_DSI_DIG |          |
| 24                | AE1                     | MIPI_DSI1_GPIO0_01         | MIPI_DSI1_GPIO0_01 | <b>ALT0:</b> MIPI_DSI1_GPIO0_IO01<br><b>ALT1:</b> I2C2_SDA<br><b>ALT2:</b><br><b>ALT3:</b><br><b>ALT4:</b> GPIO2_IO00                    | VDD_MIPI_DSI_DIG |          |
| 25                | AF1                     | QSPI0A_SS1_B               | QSPI0A_SS1_B       | <b>ALT0:</b> QSPI0A_SS1_B<br><b>ALT1:</b><br><b>ALT2:</b><br><b>ALT3:</b><br><b>ALT4:</b> GPIO3_IO15                                     | 3V3              |          |
| 26                | AG1                     | QSPI0A_SCLK                | QSPI0A_SCLK        | <b>ALT0:</b> QSPI0A_SCLK<br><b>ALT1:</b><br><b>ALT2:</b><br><b>ALT3:</b><br><b>ALT4:</b> GPIO3_IO16                                      | 3V3              |          |
| 27                | AH1                     | 1V8                        | -                  | -                                                                                                                                        | 1V8              |          |
| 28                | AJ1                     | GND                        | -                  | -                                                                                                                                        | -                |          |
| 29                | AK1                     | 3V3                        | -                  | -                                                                                                                                        | 3V3              |          |
| 30                | -                       | GND                        | -                  | -                                                                                                                                        | -                |          |
| 31                | -                       | VSYS2                      | -                  | -                                                                                                                                        | VSYS2            |          |
| 32                | -                       | VSYS2                      | -                  | -                                                                                                                                        | VSYS2            |          |

| Castellated pad # | Associated LGA Pad name | ConnectCore 8X signal name | i.MX 8X pin name* | Multiplexing                                                                                         | Power group       | Comments |
|-------------------|-------------------------|----------------------------|-------------------|------------------------------------------------------------------------------------------------------|-------------------|----------|
| 33                | -                       | VSYS                       | -                 | -                                                                                                    | VSYS              |          |
| 34                | -                       | GND                        | -                 | -                                                                                                    | -                 |          |
| 35                | AN4                     | QSPI0A_DQS                 | QSPI0A_DQS        | <b>ALT0:</b> QSPI0A_DQS<br><b>ALT1:</b><br><b>ALT2:</b><br><b>ALT3:</b><br><b>ALT4:</b> GPIO3_IO13   | 3V3               |          |
| 36                | AN5                     | QSPI0A_SS0_B               | QSPI0A_SS0_B      | <b>ALT0:</b> QSPI0A_SS0_B<br><b>ALT1:</b><br><b>ALT2:</b><br><b>ALT3:</b><br><b>ALT4:</b> GPIO3_IO14 | 3V3               |          |
| 37                | AN6                     | MIPI_DSI0_CLK_N            | MIPI_DSI0_CLK_N   | -                                                                                                    | NVCC_MIPI_CSI_DSI |          |
| 38                | AN7                     | MIPI_DSI0_CLK_P            | MIPI_DSI0_CLK_P   | -                                                                                                    | NVCC_MIPI_CSI_DSI |          |
| 39                | AN8                     | GND                        | -                 | -                                                                                                    | -                 |          |
| 40                | AN9                     | MIPI_DSI0_DATA0_N          | MIPI_DSI0_DATA0_N | -                                                                                                    | NVCC_MIPI_CSI_DSI |          |
| 41                | AN10                    | MIPI_DSI0_DATA0_P          | MIPI_DSI0_DATA0_P | -                                                                                                    | NVCC_MIPI_CSI_DSI |          |
| 42                | AN11                    | GND                        | -                 | -                                                                                                    | -                 |          |
| 43                | AN12                    | MIPI_DSI0_DATA1_N          | MIPI_DSI0_DATA1_N | -                                                                                                    | NVCC_MIPI_CSI_DSI |          |
| 44                | AN13                    | MIPI_DSI0_DATA1_P          | MIPI_DSI0_DATA1_P | -                                                                                                    | NVCC_MIPI_CSI_DSI |          |
| 45                | AN14                    | GND                        | -                 | -                                                                                                    | -                 |          |
| 46                | AN15                    | MIPI_DSI0_DATA2_N          | MIPI_DSI0_DATA2_N | -                                                                                                    | NVCC_MIPI_CSI_DSI |          |
| 47                | AN16                    | MIPI_DSI0_DATA2_P          | MIPI_DSI0_DATA2_P | -                                                                                                    | NVCC_MIPI_CSI_DSI |          |

| Castellated pad # | Associated LGA Pad name | ConnectCore 8X signal name | i.MX 8X pin name* | Multiplexing                                                                                                                                                                                            | Power group       | Comments |
|-------------------|-------------------------|----------------------------|-------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|----------|
| 48                | AN17                    | GND                        | -                 | -                                                                                                                                                                                                       | -                 |          |
| 49                | AN18                    | MIPI_DSI0_DATA3_N          | MIPI_DSI0_DATA3_N | -                                                                                                                                                                                                       | NVCC_MIPI_CSI_DSI |          |
| 50                | AN19                    | MIPI_DSI0_DATA3_P          | MIPI_DSI0_DATA3_P | -                                                                                                                                                                                                       | NVCC_MIPI_CSI_DSI |          |
| 51                | AN20                    | GND                        | -                 | -                                                                                                                                                                                                       | -                 |          |
| 52                | AN21                    | MCA_IO1                    | -                 | <b>ALT0:</b> ADC0_DP1/ADC0_SE1<br><b>ALT1:</b> PTE16<br><b>ALT2:</b> SPI0_PCS0<br><b>ALT3:</b> UART2_TX<br><b>ALT4:</b> TPM_CLKIN0<br><b>ALT5:</b><br><b>ALT6:</b> FXIO0_D0<br><b>ALT7:</b>             | VCC_MCA           |          |
| 53                | AN22                    | MCA_IO2                    | -                 | <b>ALT0:</b> ADC0_DM1/ADC0_SE5a<br><b>ALT1:</b> PTE17<br><b>ALT2:</b> SPI0_SCK<br><b>ALT3:</b> UART2_RX<br><b>ALT4:</b> TPM_CLKIN1<br><b>ALT5:</b> LPTMR0_ALT3<br><b>ALT6:</b> FXIO0_D1<br><b>ALT7:</b> | VCC_MCA           |          |
| 54                | AN23                    | MCA_IO3                    | -                 | <b>ALT0:</b> ADC0_DP2/ADC0_SE2<br><b>ALT1:</b> PTE18<br><b>ALT2:</b> SPI0_MOSI<br><b>ALT3:</b><br><b>ALT4:</b> I2C0_SDA<br><b>ALT5:</b> SPI0_MISO<br><b>ALT6:</b> FXIO0_D2<br><b>ALT7:</b>              | VCC_MCA           |          |

| Castellated pad # | Associated LGA Pad name | ConnectCore 8X signal name | i.MX 8X pin name* | Multiplexing                                                                                                                                                | Power group | Comments                                            |
|-------------------|-------------------------|----------------------------|-------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|-----------------------------------------------------|
| 55                | AN24                    | SWD_CLK/PWR_IO             | -                 | <b>ALT0:</b><br><b>ALT1:</b> PTA0<br><b>ALT2:</b><br><b>ALT3:</b> TPM0_CH5<br><b>ALT4:</b><br><b>ALT5:</b><br><b>ALT6:</b><br><b>ALT7:</b> SWD_CLK          | VCC_MCA     | Input power ON/OFF line of the module (active low). |
| 56                | AN25                    | SYS_RESET                  | -                 | -                                                                                                                                                           | VCC_MCA     | Input reset line of the module (active low).        |
| 57                | AN26                    | SWD_DIO/MCA_IO0            | -                 | <b>ALT0:</b><br><b>ALT1:</b> PTA3<br><b>ALT2:</b> I2C1_SCL<br><b>ALT3:</b> TPM0_CH0<br><b>ALT4:</b><br><b>ALT5:</b><br><b>ALT6:</b><br><b>ALT7:</b> SWD_DIO | VCC_MCA     |                                                     |
| 58                | AM27                    | MCA_VIN_DET                | -                 | -                                                                                                                                                           | VCC_MCA     |                                                     |
| 59                | -                       | VCC_MCA                    | -                 | -                                                                                                                                                           | VCC_MCA     |                                                     |
| 60                | -                       | GND                        | -                 | -                                                                                                                                                           | -           |                                                     |

| Castellated pad # | Associated LGA Pad name | ConnectCore 8X signal name | i.MX 8X pin name* | Multiplexing                                                                                                                                                                                | Power group | Comments |
|-------------------|-------------------------|----------------------------|-------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|----------|
| 61                | AL27                    | MCA_IO4                    | -                 | <b>ALT0:</b> ADC0_DM2/ADC0_SE6a<br><b>ALT1:</b> PTE19<br><b>ALT2:</b> SPI0_MISO<br><b>ALT3:</b><br><b>ALT4:</b> I2C0_SCL<br><b>ALT5:</b> SPI0_MOSI<br><b>ALT6:</b> FXIO0_D3<br><b>ALT7:</b> | VCC_MCA     |          |
| 62                | AL28                    | MCA_IO5                    | -                 | <b>ALT0:</b> ADC0_DP0/ADC0_SE0<br><b>ALT1:</b> PTE20<br><b>ALT2:</b><br><b>ALT3:</b> TPM1_CH0<br><b>ALT4:</b> LPUART0_TX<br><b>ALT5:</b><br><b>ALT6:</b> FXIO0_D4<br><b>ALT7:</b>           | VCC_MCA     |          |
| 63                | AK29                    | MCA_IO6                    | -                 | <b>ALT0:</b> ADC0_DM0/ADC0_SE4a<br><b>ALT1:</b> PTE21<br><b>ALT2:</b><br><b>ALT3:</b> PTM1_CH1<br><b>ALT4:</b> LPUART0_RX<br><b>ALT5:</b><br><b>ALT6:</b> FXIO0_D5<br><b>ALT7:</b>          | VCC_MCA     |          |

| Castellated pad # | Associated LGA Pad name | ConnectCore 8X signal name | i.MX 8X pin name* | Multiplexing                                                                                                                                                                     | Power group | Comments |
|-------------------|-------------------------|----------------------------|-------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|----------|
| 64                | AJ29                    | MCA_IO7                    | -                 | <b>ALT0:</b> ADC0_DP3/ADC0_SE3<br><b>ALT1:</b> PTE22<br><b>ALT2:</b><br><b>ALT3:</b> TPM2_CH0<br><b>ALT4:</b> UART2_TX<br><b>ALT5:</b><br><b>ALT6:</b> FXIO0_D6<br><b>ALT7:</b>  | VCC_MCA     |          |
| 65                | AH29                    | MCA_IO8                    | -                 | <b>ALT0:</b> ADC0_DM3/ADC0_SE7a<br><b>ALT1:</b> PTE23<br><b>ALT2:</b><br><b>ALT3:</b> TPM2_CH1<br><b>ALT4:</b> UART2_RX<br><b>ALT5:</b><br><b>ALT6:</b> FXIO0_D7<br><b>ALT7:</b> | VCC_MCA     |          |
| 66                | AG29                    | MCA_IO9                    | -                 | <b>ALT0:</b><br><b>ALT1:</b> PTA1<br><b>ALT2:</b> LPUART0_RX<br><b>ALT3:</b> TPM2_CH0<br><b>ALT4:</b><br><b>ALT5:</b><br><b>ALT6:</b><br><b>ALT7:</b>                            | VCC_MCA     |          |

| Castellated pad # | Associated LGA Pad name | ConnectCore 8X signal name | i.MX 8X pin name* | Multiplexing                                                                                                                                          | Power group | Comments                                           |
|-------------------|-------------------------|----------------------------|-------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|----------------------------------------------------|
| 67                | AF29                    | MCA_IO10                   | -                 | <b>ALT0:</b><br><b>ALT1:</b> PTA2<br><b>ALT2:</b> LPUART0_TX<br><b>ALT3:</b> TPM2_CH1<br><b>ALT4:</b><br><b>ALT5:</b><br><b>ALT6:</b><br><b>ALT7:</b> | VCC_MCA     |                                                    |
| 68                | AE29                    | SCU_BOOT_MODE0             | SCU_BOOT_MODE0    | -                                                                                                                                                     | VCC_SCU_1V8 |                                                    |
| 69                | AD29                    | SCU_BOOT_MODE1             | SCU_BOOT_MODE1    | -                                                                                                                                                     | VCC_SCU_1V8 |                                                    |
| 70                | AC29                    | SCU_GPIO0_00               | SCU_GPIO0_00      | <b>ALT0:</b> SCU_GPIO0_IO00<br><b>ALT1:</b> SCU_UART0_RX<br><b>ALT2:</b> M40_UART0_RX<br><b>ALT3:</b> UART3_RX<br><b>ALT4:</b> GPIO2_IO03             | VCC_SCU_1V8 |                                                    |
| 71                | AB29                    | SCU_GPIO0_01               | SCU_GPIO0_01      | <b>ALT0:</b> SCU_GPIO0_IO01<br><b>ALT1:</b> SCU_UART0_TX<br><b>ALT2:</b> M40_UART0_TX<br><b>ALT3:</b> UART3_TX<br><b>ALT4:</b> SCU_WDOG0_WDOG_OUT     | VCC_SCU_1V8 |                                                    |
| 72                | AA29                    | VCC_SCU_1V8                | -                 | -                                                                                                                                                     | VCC_SCU_1V8 | Do not use this power rail unless otherwise noted. |
| 73                | Y29                     | GND                        | -                 | -                                                                                                                                                     | -           |                                                    |

| Castellated pad # | Associated LGA Pad name | ConnectCore 8X signal name | i.MX 8X pin name* | Multiplexing                                                                                                                       | Power group | Comments |
|-------------------|-------------------------|----------------------------|-------------------|------------------------------------------------------------------------------------------------------------------------------------|-------------|----------|
| 74                | W29                     | UART2_TX                   | UART2_TX          | <b>ALT0:</b> UART2_TX<br><b>ALT1:</b> FTM_CH1<br><b>ALT2:</b> FLEXCAN1_TX<br><b>ALT3:</b><br><b>ALT4:</b> GPIO1_IO23               | 3V3         |          |
| 75                | V29                     | UART2_RX                   | UART2_RX          | <b>ALT0:</b> UART2_RX<br><b>ALT1:</b> FTM_CH0<br><b>ALT2:</b> FLEXCAN1_RX<br><b>ALT3:</b><br><b>ALT4:</b> GPIO1_IO24               | 3V3         |          |
| 76                | U29                     | FLEXCAN2_RX                | FLEXCAN2_RX       | <b>ALT0:</b> FLEXCAN2_RX<br><b>ALT1:</b> SAI3_RXD<br><b>ALT2:</b> UART3_RX<br><b>ALT3:</b> SAI1_RXFS<br><b>ALT4:</b> GPIO1_IO19    | 3V3         |          |
| 77                | T29                     | FLEXCAN2_TX                | FLEXCAN2_TX       | <b>ALT0:</b> FLEXCAN2_TX<br><b>ALT1:</b> SAI3_RXFS<br><b>ALT2:</b> UART3_TX<br><b>ALT3:</b> SAI1_RXC<br><b>ALT4:</b> GPIO1_IO20    | 3V3         |          |
| 78                | R29                     | FLEXCAN1_RX                | FLEXCAN1_RX       | <b>ALT0:</b> FLEXCAN1_RX<br><b>ALT1:</b> SAI2_RXFS<br><b>ALT2:</b> FTM_CH2<br><b>ALT3:</b> SAI1_TXD<br><b>ALT4:</b> GPIO1_IO17     | 3V3         |          |
| 79                | P29                     | FLEXCAN1_TX                | FLEXCAN1_TX       | <b>ALT0:</b> FLEXCAN1_TX<br><b>ALT1:</b> SAI3_RXC<br><b>ALT2:</b> DMA0_REQ_IN0<br><b>ALT3:</b> SAI1_RXD<br><b>ALT4:</b> GPIO1_IO18 | 3V3         |          |

| Castellated pad # | Associated LGA Pad name | ConnectCore 8X signal name | i.MX 8X pin name* | Multiplexing                                                                                                                         | Power group | Comments |
|-------------------|-------------------------|----------------------------|-------------------|--------------------------------------------------------------------------------------------------------------------------------------|-------------|----------|
| 80                | N29                     | FLEXCAN0_RX                | FLEXCAN0_RX       | <b>ALT0:</b> FLEXCAN0_RX<br><b>ALT1:</b> SAI2_RXC<br><b>ALT2:</b> UART0_RTS_B<br><b>ALT3:</b> SAI1_TXC<br><b>ALT4:</b> GPIO1_IO15    | 3V3         |          |
| 81                | M29                     | FLEXCAN0_TX                | FLEXCAN0_TX       | <b>ALT0:</b> FLEXCAN0_TX<br><b>ALT1:</b> SAI2_RXD<br><b>ALT2:</b> UART0_CTS_B<br><b>ALT3:</b> SAI1_TXFS<br><b>ALT4:</b> GPIO1_IO16   | 3V3         |          |
| 82                | L29                     | ADC_IN1                    | ADC_IN1           | <b>ALT0:</b> ADC_IN1<br><b>ALT1:</b> M40_I2C0_SDA<br><b>ALT2:</b> M40_GPIO0_IO01<br><b>ALT3:</b><br><b>ALT4:</b> GPIO1_IO09          | 1V8         |          |
| 83                | K29                     | ADC_IN0                    | ADC_IN0           | <b>ALT0:</b> ADC_IN0<br><b>ALT1:</b> M40_I2C0_SCL<br><b>ALT2:</b> M40_GPIO0_IO00<br><b>ALT3:</b><br><b>ALT4:</b> GPIO1_IO10          | 1V8         |          |
| 84                | J29                     | ADC_VREFH                  | -                 | -                                                                                                                                    | -           |          |
| 85                | H29                     | GND                        | -                 | -                                                                                                                                    | -           |          |
| 86                | G29                     | MCLK_OUT0                  | MCLK_OUT0         | <b>ALT0:</b> MCLK_OUT0<br><b>ALT1:</b> ESAI0_TX_HF_CLK<br><b>ALT2:</b> LCDIF_CLK<br><b>ALT3:</b> SPI2_SDO<br><b>ALT4:</b> GPIO0_IO20 | 3V3         |          |

| Castellated pad # | Associated LGA Pad name | ConnectCore 8X signal name | i.MX 8X pin name* | Multiplexing                                                                                                                          | Power group | Comments |
|-------------------|-------------------------|----------------------------|-------------------|---------------------------------------------------------------------------------------------------------------------------------------|-------------|----------|
| 87                | F29                     | MCLK_IN0                   | MCLK_IN0          | <b>ALT0:</b> MCLK_IN0<br><b>ALT1:</b> ESAI0_RX_HF_CLK<br><b>ALT2:</b> LCDIF_VSYNC<br><b>ALT3:</b> SPI2_SDI<br><b>ALT4:</b> GPIO0_IO19 | 3V3         |          |
| 88                | E29                     | MCLK_IN1                   | MCLK_IN1          | <b>ALT0:</b> MCLK_IN1<br><b>ALT1:</b> I2C3_SDA<br><b>ALT2:</b> LCDIF_EN<br><b>ALT3:</b> SPI2_SCK<br><b>ALT4:</b> LCDIF_D17            | 3V3         |          |
| 89                | F28                     | SPI3_CS1                   | SPI3_CS1          | <b>ALT0:</b> SPI3_CS1<br><b>ALT1:</b> I2C3_SCL<br><b>ALT2:</b> LCDIF_RESET<br><b>ALT3:</b> SPI2_CS0<br><b>ALT4:</b> LCDIF_D16         | 3V3         |          |
| 90                | E28                     | SPI3_SCK                   | SPI3_SCK          | <b>ALT0:</b> SPI3_SCK<br><b>ALT1:</b><br><b>ALT2:</b> LCDIF_D13<br><b>ALT3:</b><br><b>ALT4:</b> GPIO0_IO13                            | 3V3         |          |
| 91                | E27                     | SPI3_SDO                   | SPI3_SDO          | <b>ALT0:</b> SPI3_SDO<br><b>ALT1:</b><br><b>ALT2:</b> LCDIF_D14<br><b>ALT3:</b><br><b>ALT4:</b> GPIO0_IO14                            | 3V3         |          |
| 92                | C24                     | SPI3_SDI                   | SPI3_SDI          | <b>ALT0:</b> SPI3_SDI<br><b>ALT1:</b><br><b>ALT2:</b> LCDIF_D15<br><b>ALT3:</b><br><b>ALT4:</b> GPIO0_IO15                            | 3V3         |          |

| Castellated pad # | Associated LGA Pad name | ConnectCore 8X signal name | i.MX 8X pin name*  | Multiplexing                                                                                                                                          | Power group | Comments |
|-------------------|-------------------------|----------------------------|--------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|----------|
| 93                | B24                     | SPI3_CS0                   | SPI3_CS0           | <b>ALT0:</b> SPI3_CS0<br><b>ALT1:</b> MCLK_OUT1<br><b>ALT2:</b> LCDIF_HSYNC<br><b>ALT3:</b><br><b>ALT4:</b> GPIO0_IO16                                | 3V3         |          |
| 94                | -                       | GND                        | -                  | -                                                                                                                                                     | -           |          |
| 95                | -                       | VDD_ENET0                  | -                  | -                                                                                                                                                     | VDD_ENET0   |          |
| 96                | A24                     | ENET0_RGMII_TXC            | ENET0_RGMII_TXC    | <b>ALT0:</b> ENET0_RGMII_TXC<br><b>ALT1:</b> ENET0_RCLK50M_OUT<br><b>ALT2:</b> ENET0_RCLK50M_IN<br><b>ALT3:</b> NAND_CE1_B<br><b>ALT4:</b> GPIO4_IO29 | VDD_ENET0   |          |
| 97                | A23                     | ENET0_RGMII_TX_CTL         | ENET0_RGMII_TX_CTL | <b>ALT0:</b> ENET0_RGMII_TX_CTL<br><b>ALT1:</b><br><b>ALT2:</b><br><b>ALT3:</b> USDHC1_RESET_B<br><b>ALT4:</b> GPIO4_IO30                             | VDD_ENET0   |          |
| 98                | A22                     | ENET0_RGMII_TXD0           | ENET0_RGMII_TXD0   | <b>ALT0:</b> ENET0_RGMII_TXD0<br><b>ALT1:</b><br><b>ALT2:</b><br><b>ALT3:</b> USDHC1_VSELECT<br><b>ALT4:</b> GPIO4_IO31                               | VDD_ENET0   |          |
| 99                | A21                     | ENET0_RGMII_TXD1           | ENET0_RGMII_TXD1   | <b>ALT0:</b> ENET0_RGMII_TXD1<br><b>ALT1:</b><br><b>ALT2:</b><br><b>ALT3:</b> USDHC1_WP<br><b>ALT4:</b> GPIO5_IO00                                    | VDD_ENET0   |          |

| Castellated pad # | Associated LGA Pad name | ConnectCore 8X signal name | i.MX 8X pin name*  | Multiplexing                                                                                                                            | Power group | Comments |
|-------------------|-------------------------|----------------------------|--------------------|-----------------------------------------------------------------------------------------------------------------------------------------|-------------|----------|
| 100               | A20                     | ENET0_RGMII_TXD2           | ENET0_RGMII_TXD2   | <b>ALT0:</b> ENET0_RGMII_TXD2<br><b>ALT1:</b> MLB_CLK<br><b>ALT2:</b> NAND_CE0_B<br><b>ALT3:</b> USDHC1_CD_B<br><b>ALT4:</b> GPIO5_IO01 | VDD_ENET0   |          |
| 101               | A19                     | ENET0_RGMII_TXD3           | ENET0_RGMII_TXD3   | <b>ALT0:</b> ENET0_RGMII_TXD3<br><b>ALT1:</b> MLB_SIG<br><b>ALT2:</b> NAND_RE_B<br><b>ALT3:</b><br><b>ALT4:</b> GPIO5_IO02              | VDD_ENET0   |          |
| 102               | A18                     | ENET0_RGMII_RXC            | ENET0_RGMII_RXC    | <b>ALT0:</b> ENET0_RGMII_RXC<br><b>ALT1:</b> MLB_DATA<br><b>ALT2:</b> NAND_WE_B<br><b>ALT3:</b> USDHC1_CLK<br><b>ALT4:</b> GPIO5_IO03   | VDD_ENET0   |          |
| 103               | A17                     | ENET0_RGMII_RX_CTL         | ENET0_RGMII_RX_CTL | <b>ALT0:</b> ENET0_RGMII_RX_CTL<br><b>ALT1:</b><br><b>ALT2:</b><br><b>ALT3:</b> USDHC1_CMD<br><b>ALT4:</b> GPIO5_IO04                   | VDD_ENET0   |          |
| 104               | A16                     | ENET0_RGMII_RXD0           | ENET0_RGMII_RXD0   | <b>ALT0:</b> ENET0_RGMII_RXD0<br><b>ALT1:</b><br><b>ALT2:</b><br><b>ALT3:</b> USDHC1_DATA0<br><b>ALT4:</b> GPIO5_IO05                   | VDD_ENET0   |          |
| 105               | A15                     | ENET0_RGMII_RXD1           | ENET0_RGMII_RXD1   | <b>ALT0:</b> ENET0_RGMII_RXD1<br><b>ALT1:</b><br><b>ALT2:</b><br><b>ALT3:</b> USDHC1_DATA1<br><b>ALT4:</b> GPIO5_IO06                   | VDD_ENET0   |          |

| Castellated pad # | Associated LGA Pad name | ConnectCore 8X signal name | i.MX 8X pin name*     | Multiplexing                                                                                                                           | Power group | Comments |
|-------------------|-------------------------|----------------------------|-----------------------|----------------------------------------------------------------------------------------------------------------------------------------|-------------|----------|
| 106               | A14                     | ENET0_RGMII_RXD2           | ENET0_RGMII_RXD2      | <b>ALT0:</b> ENET0_RGMII_RXD2<br><b>ALT1:</b> ENET0_RMII_RX_ER<br><b>ALT2:</b><br><b>ALT3:</b> USDHC1_DATA2<br><b>ALT4:</b> GPIO5_IO07 | VDD_ENET0   |          |
| 107               | A13                     | ENET0_RGMII_RXD3           | ENET0_RGMII_RXD3      | <b>ALT0:</b> ENET0_RGMII_RXD3<br><b>ALT1:</b><br><b>ALT2:</b> NAND_ALE<br><b>ALT3:</b> USDHC1_DATA3<br><b>ALT4:</b> GPIO5_IO08         | VDD_ENET0   |          |
| 108               | A12                     | ENET0_REFCLK_125M_25M      | ENET0_REFCLK_125M_25M | <b>ALT0:</b> ENET0_REFCLK_125M_25M<br><b>ALT1:</b> ENET0_PPS<br><b>ALT2:</b> ENET1_PPS<br><b>ALT3:</b><br><b>ALT4:</b> GPIO5_IO09      | VDD_ENET0   |          |
| 109               | A11                     | ENET0_MDIO                 | ENET0_MDIO            | <b>ALT0:</b> ENET0_MDIO<br><b>ALT1:</b> I2C3_SDA<br><b>ALT2:</b> ENET1_MDIO<br><b>ALT3:</b><br><b>ALT4:</b> GPIO5_IO10                 | VDD_ENET0   |          |
| 110               | A10                     | ENET0_MDC                  | ENET0_MDC             | <b>ALT0:</b> ENET0_MDC<br><b>ALT1:</b> I2C3_SCL<br><b>ALT2:</b> ENET1_MDC<br><b>ALT3:</b><br><b>ALT4:</b> GPIO5_IO11                   | VDD_ENET0   |          |
| 111               | A9                      | USB_OTG2_P                 | USB_OTG2_DP           | -                                                                                                                                      | 3V3         |          |
| 112               | A8                      | USB_OTG2_N                 | USB_OTG2_DN           | -                                                                                                                                      | 3V3         |          |
| 113               | A7                      | USB_OTG1_P                 | USB_OTG1_DP           | -                                                                                                                                      | 3V3         |          |

| Castellated pad # | Associated LGA Pad name | ConnectCore 8X signal name | i.MX 8X pin name* | Multiplexing | Power group | Comments |
|-------------------|-------------------------|----------------------------|-------------------|--------------|-------------|----------|
| 114               | A6                      | USB_OTG1_N                 | USB_OTG1_DN       | -            | 3V3         |          |
| 115               | -                       | GND                        | -                 | -            | -           |          |
| 116               | B6                      | USB_OTG1_VBUS              | -                 | -            | -           |          |
| 117               | D4                      | GND                        | -                 | -            | -           |          |
| 118               | C6                      | USB_OTG1_ID                | USB_OTG1_ID       | -            | 3V3         |          |

## Extended LGA version

| LGA pad name | ConnectCore 8X signal name | i.MX 8X pad name* | Multiplexing | Power Group | Comments |
|--------------|----------------------------|-------------------|--------------|-------------|----------|
| A4           | GND                        | -                 | -            | -           |          |
| A5           | GND                        | -                 | -            | -           |          |
| A25          | GND                        | -                 | -            | -           |          |
| A26          | RESERVED                   | -                 | -            | -           |          |
| B3           | GND                        | -                 | -            | -           |          |
| B4           | GND                        | -                 | -            | -           |          |
| B5           | GND                        | -                 | -            | -           |          |
| B7           | RESERVED                   | -                 | -            | -           |          |
| B8           | GND                        | -                 | -            | -           |          |
| B9           | USB_SS3_TX_N               | USB_SS3_TX_N      | -            | 1V8         |          |
| B10          | USB_SS3_TX_P               | USB_SS3_TXP       | -            | 1V8         |          |
| B11          | GND                        | -                 | -            | -           |          |
| B12          | USB_SS3_RX_N               | USB_SS3_RX_N      | -            | 1V8         |          |
| B13          | USB_SS3_RX_P               | USB_SS3_RX_P      | -            | 1V8         |          |
| B14          | GND                        | -                 | -            | -           |          |
| B15          | GND                        | -                 | -            | -           |          |
| B16          | WLAN_RF_KILL#              | -                 | -            | 3V3_RF      |          |
| B17          | BT_RF_KILL#                | -                 | -            | 3V3_RF      |          |

| LGA pad name | ConnectCore 8X signal name | i.MX 8X pad name* | Multiplexing                                                                                                                                        | Power Group    | Comments |
|--------------|----------------------------|-------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|----------------|----------|
| B18          | GND                        | -                 | -                                                                                                                                                   | -              |          |
| B19          | ESAI0_SCKR                 | ESAI0_SCKR        | <b>ALT0:</b> ESAI0_SCKR<br><b>ALT1:</b><br><b>ALT2:</b> LCDIF_D02<br><b>ALT3:</b> ENET1_RGMII_TX_CTL<br><b>ALT4:</b> GPIO0_IO02                     | VDD_ESAI_SPDIF |          |
| B20          | ESAI0_FSR                  | ESAI0_FSR         | <b>ALT0:</b> ESAI0_FSR<br><b>ALT1:</b> ENET1_RCLK50M_OUT<br><b>ALT2:</b> LCDIF_D00<br><b>ALT3:</b> ENET1_RGMII_TXC<br><b>ALT4:</b> ENET1_RCLK50M_IN | VDD_ESAI_SPDIF |          |
| B21          | ESAI0_SCKT                 | ESAI0_SCKT        | <b>ALT0:</b> ESAI0_SCKT<br><b>ALT1:</b> MLB_SIG<br><b>ALT2:</b> LCDIF_D03<br><b>ALT3:</b> ENET1_RGMII_TXD3<br><b>ALT4:</b> GPIO0_IO03               | VDD_ESAI_SPDIF |          |
| B22          | ESAI0_TX1                  | ESAI0_TX1         | <b>ALT0:</b> ESAI0_TX1<br><b>ALT1:</b><br><b>ALT2:</b> LCDIF_D05<br><b>ALT3:</b> ENET1_RGMII_RXD3<br><b>ALT4:</b> GPIO0_IO05                        | VDD_ESAI_SPDIF |          |
| B23          | RESERVED                   | -                 | -                                                                                                                                                   | -              |          |
| B25          | GND                        | -                 | -                                                                                                                                                   | -              |          |
| B26          | GND                        | -                 | -                                                                                                                                                   | -              |          |
| B27          | GND                        | -                 | -                                                                                                                                                   | -              |          |
| C2           | GND                        | -                 | -                                                                                                                                                   | -              |          |

| LGA pad name | ConnectCore 8X signal name | i.MX 8X pad name* | Multiplexing                                                                                                               | Power Group | Comments                        |
|--------------|----------------------------|-------------------|----------------------------------------------------------------------------------------------------------------------------|-------------|---------------------------------|
| C3           | RF_ANT2_INT                | -                 | -                                                                                                                          | -           | Internal secondary antenna pad. |
| C4           | GND                        | -                 | -                                                                                                                          | -           |                                 |
| C5           | GND                        | -                 | -                                                                                                                          | -           |                                 |
| C7           | USB_SS3_TC1                | USB_SS3_TC1       | <b>ALT0:</b> I2C1_SCL<br><b>ALT1:</b> USB_OTG2_PWR<br><b>ALT2:</b><br><b>ALT3:</b><br><b>ALT4:</b> GPIO4_IO04              | 3V3         |                                 |
| C8           | USB_SS3_TC0                | USB_SS3_TC0       | <b>ALT0:</b> I2C1_SCL<br><b>ALT1:</b> USB_OTG1_PWR<br><b>ALT2:</b> USB_OTG2_PWR<br><b>ALT3:</b><br><b>ALT4:</b> GPIO4_IO03 | 3V3         |                                 |
| C9           | USB_SS3_TC2                | USB_SS3_TC2       | <b>ALT0:</b> I2C1_SDA<br><b>ALT1:</b> USB_OTG1_OC<br><b>ALT2:</b> USB_OTG2_OC<br><b>ALT3:</b><br><b>ALT4:</b> GPIO4_IO05   | 3V3         |                                 |
| C10          | USB_OTG2_ID                | USB_OTG2_ID       | -                                                                                                                          | 3V3         |                                 |
| C11          | USB_SS3_TC3                | USB_SS3_TC3       | <b>ALT0:</b> I2C1_SDA<br><b>ALT1:</b> USB_OTG2_OC<br><b>ALT2:</b><br><b>ALT3:</b><br><b>ALT4:</b> GPIO4_IO06               | 3V3         |                                 |
| C12          | GND                        | -                 | -                                                                                                                          | -           |                                 |
| C13          | GND                        | -                 | -                                                                                                                          | -           |                                 |

| LGA pad name | ConnectCore 8X signal name | i.MX 8X pad name* | Multiplexing                                                                                                                                      | Power Group    | Comments |
|--------------|----------------------------|-------------------|---------------------------------------------------------------------------------------------------------------------------------------------------|----------------|----------|
| C14          | GND                        | -                 | -                                                                                                                                                 | -              |          |
| C15          | GND                        | -                 | -                                                                                                                                                 | -              |          |
| C16          | GND                        | -                 | -                                                                                                                                                 | -              |          |
| C17          | SPI2_CS0                   | SPI2_CS0          | <b>ALT0:</b> SPI2_CS0<br><b>ALT1:</b><br><b>ALT2:</b><br><b>ALT3:</b><br><b>ALT4:</b> GPIO1_IO00                                                  | VDD_SPI_SAI    |          |
| C18          | SPI2_SDI                   | SPI2_SDI          | <b>ALT0:</b> SPI2_SDI<br><b>ALT1:</b><br><b>ALT2:</b><br><b>ALT3:</b><br><b>ALT4:</b> GPIO1_IO02                                                  | VDD_SPI_SAI    |          |
| C19          | SAI0_TXFS                  | SAI0_TXFS         | <b>ALT0:</b> SAI0_TXFS<br><b>ALT1:</b> SPI2_CS1<br><b>ALT2:</b> SPI1_SCK<br><b>ALT3:</b><br><b>ALT4:</b> GPIO0_IO28                               | VDD_SPI_SAI    |          |
| C20          | ESAI0_TX2_RX3              | ESAI0_TX2_RX3     | <b>ALT0:</b> ESAI0_TX2_RX3<br><b>ALT1:</b> ENET1_RMII_RX_ER<br><b>ALT2:</b> LCDIF_D06<br><b>ALT3:</b> ENET1_RGMII_RXD2<br><b>ALT4:</b> GPIO0_IO06 | VDD_ESAI_SPDIF |          |
| C21          | ESAI0_FST                  | ESAI0_FST         | <b>ALT0:</b> ESAI0_FST<br><b>ALT1:</b> MLB_CLK<br><b>ALT2:</b> LCDIF_D01<br><b>ALT3:</b> ENET1_RGMII_TXD2<br><b>ALT4:</b> GPIO0_IO01              | VDD_ESAI_SPDIF |          |

| LGA pad name | ConnectCore 8X signal name | i.MX 8X pad name* | Multiplexing                                                                                                                         | Power Group    | Comments                      |
|--------------|----------------------------|-------------------|--------------------------------------------------------------------------------------------------------------------------------------|----------------|-------------------------------|
| C22          | ESAI0_TX4_RX1              | ESAI0_TX4_RX1     | <b>ALT0:</b> ESAI0_TX4_RX1<br><b>ALT1:</b><br><b>ALT2:</b> LCDIF_D08<br><b>ALT3:</b> ENET1_RGMII_TXD0<br><b>ALT4:</b> GPIO0_IO08     | VDD_ESAI_SPDIF |                               |
| C23          | SPDIF0_TX                  | SPDIF0_TX         | <b>ALT0:</b> SPDIF0_TX<br><b>ALT1:</b> MQS_L<br><b>ALT2:</b> LCDIF_D11<br><b>ALT3:</b> ENET1_RGMII_RX_CTL<br><b>ALT4:</b> GPIO0_IO11 | VDD_ESAI_SPDIF |                               |
| C25          | GND                        | -                 | -                                                                                                                                    | -              |                               |
| C26          | GND                        | -                 | -                                                                                                                                    | -              |                               |
| C27          | RF_ANT1_INT                | -                 | -                                                                                                                                    | -              | Internal primary antenna pad. |
| C28          | GND                        | -                 | -                                                                                                                                    | -              |                               |
| D1           | RESERVED                   | -                 | -                                                                                                                                    | -              |                               |
| D2           | GND                        | -                 | -                                                                                                                                    | -              |                               |
| D3           | GND                        | -                 | -                                                                                                                                    | -              |                               |

| LGA pad name | ConnectCore 8X signal name | i.MX 8X pad name* | Multiplexing | Power Group | Comments                                                                                                                                                                                   |
|--------------|----------------------------|-------------------|--------------|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| D5           | WLAN_SD1_D3                | -                 | -            | 3V3_RF      | This SDIO interface is connected to the Wireless chip on the wireless variants of the SOM. By default, the QCA chip carried by the SOM will use the internal PCIe interface, not the SDIO. |
| D6           | WLAN_SD1_D2                | -                 | -            | 3V3_RF      |                                                                                                                                                                                            |
| D7           | WLAN_SD1_D7                | -                 | -            | 3V3_RF      |                                                                                                                                                                                            |
| D8           | WLAN_SD1_D1                | -                 | -            | 3V3_RF      |                                                                                                                                                                                            |
| D9           | WLAN_SD1_D0                | -                 | -            | 3V3_RF      |                                                                                                                                                                                            |
| D10          | WLAN_SD1_D6                | -                 | -            | 3V3_RF      |                                                                                                                                                                                            |

| LGA pad name | ConnectCore 8X signal name | i.MX 8X pad name* | Multiplexing                                                                                                                          | Power Group    | Comments |
|--------------|----------------------------|-------------------|---------------------------------------------------------------------------------------------------------------------------------------|----------------|----------|
| D11          | WLAN_SD1_CMD               | -                 | -                                                                                                                                     | 3V3_RF         |          |
| D12          | WLAN_SD1_CLK               | -                 | -                                                                                                                                     | 3V3_RF         |          |
| D13          | WLAN_SD1_D5                | -                 | -                                                                                                                                     | 3V3_RF         |          |
| D14          | WLAN_SD1_D4                | -                 | -                                                                                                                                     | 3V3_RF         |          |
| D15          | VDD_ENET0                  | -                 | -                                                                                                                                     | VDD_ENET0      |          |
| D16          | GND                        | -                 | -                                                                                                                                     | -              |          |
| D17          | SPI0_SCK                   | SPI0_SCK          | <b>ALT0:</b> SPI0_SCK<br><b>ALT1:</b> SAI0_TXC<br><b>ALT2:</b> M40_I2C0_SCL<br><b>ALT3:</b> M40_GPIO0_IO00<br><b>ALT4:</b> GPIO1_IO04 | VDD_SPI_SAI    |          |
| D18          | SPI2_SDO                   | SPI2_SDO          | <b>ALT0:</b> SPI2_SDO<br><b>ALT1:</b><br><b>ALT2:</b><br><b>ALT3:</b><br><b>ALT4:</b> GPIO1_IO01                                      | VDD_SPI_SAI    |          |
| D19          | SAI1_RXD                   | SAI1_RXD          | <b>ALT0:</b> SAI1_RXD<br><b>ALT1:</b> SAI0_RXFS<br><b>ALT2:</b> SPI1_CS1<br><b>ALT3:</b> LCDIF_D21<br><b>ALT4:</b> GPIO0_IO29         | VDD_SPI_SAI    |          |
| D20          | ESAI0_TX5_RX0              | ESAI0_TX5_RX0     | <b>ALT0:</b> ESAI0_TX5_RX0<br><b>ALT1:</b><br><b>ALT2:</b> LCDIF_D09<br><b>ALT3:</b> ENET1_RGMII_TXD1<br><b>ALT4:</b> GPIO0_IO09      | VDD_ESAI_SPDIF |          |

| LGA pad name | ConnectCore 8X signal name | i.MX 8X pad name* | Multiplexing                                                                                                                           | Power Group    | Comments |
|--------------|----------------------------|-------------------|----------------------------------------------------------------------------------------------------------------------------------------|----------------|----------|
| D21          | SPDIF0_RX                  | SPDIF0_RX         | <b>ALT0:</b> SPDIF0_RX<br><b>ALT1:</b> MQS_R<br><b>ALT2:</b> LCDIF_D10<br><b>ALT3:</b> ENET1_RGMII_RXD0<br><b>ALT4:</b> GPIO0_IO10     | VDD_ESAI_SPDIF |          |
| D22          | ESAI0_TX0                  | ESAI0_TX0         | <b>ALT0:</b> ESAI0_TX0<br><b>ALT1:</b> MLB_DATA<br><b>ALT2:</b> LCDIF_D04<br><b>ALT3:</b> ENET1_RGMII_RXC<br><b>ALT4:</b> GPIO0_IO04   | VDD_ESAI_SPDIF |          |
| D23          | ESAI0_TX3_RX2              | ESAI0_TX3_RX2     | <b>ALT0:</b> ESAI0_TX3_RX2<br><b>ALT1:</b><br><b>ALT2:</b> LCDIF_D07<br><b>ALT3:</b> ENET1_RGMII_RXD1<br><b>ALT4:</b> GPIO0_IO07       | VDD_ESAI_SPDIF |          |
| D24          | GND                        | -                 | -                                                                                                                                      | -              |          |
| D25          | SPDIF0_EXT_CLK             | SPDIF0_EXT_CLK    | <b>ALT0:</b> SPDIF0_EXT_CLK<br><b>ALT1:</b><br><b>ALT2:</b> LCDIF_D12<br><b>ALT3:</b> ENET1_REFCLK_125M_25M<br><b>ALT4:</b> GPIO0_IO12 | VDD_ESAI_SPDIF |          |
| D26          | GND                        | -                 | -                                                                                                                                      | -              |          |
| D27          | GND                        | -                 | -                                                                                                                                      | -              |          |
| D28          | GND                        | -                 | -                                                                                                                                      | -              |          |
| D29          | GND                        | -                 | -                                                                                                                                      | -              |          |
| E1           | GND                        | -                 | -                                                                                                                                      | -              |          |

| LGA pad name | ConnectCore 8X signal name | i.MX 8X pad name* | Multiplexing                                                                                                                    | Power Group | Comments                                                                                                     |
|--------------|----------------------------|-------------------|---------------------------------------------------------------------------------------------------------------------------------|-------------|--------------------------------------------------------------------------------------------------------------|
| E2           | GND                        | -                 | -                                                                                                                               | -           |                                                                                                              |
| E5           | VDD_EMMC0                  | -                 | -                                                                                                                               | VDD_EMMC0   | Do not use this power rail unless otherwise noted.                                                           |
| E6           | GND                        | -                 | -                                                                                                                               | -           |                                                                                                              |
| E7           | RESERVED                   | -                 | -                                                                                                                               | -           |                                                                                                              |
| E8           | GND                        | -                 | -                                                                                                                               | -           |                                                                                                              |
| E9           | GPS_COEX                   | -                 | -                                                                                                                               | 3V3_RF      |                                                                                                              |
| E10          | LTE_PRI                    | -                 | -                                                                                                                               | 3V3_RF      |                                                                                                              |
| E11          | LTE_SYNC                   | -                 | -                                                                                                                               | 3V3_RF      |                                                                                                              |
| E12          | BT_UART1_RX                | UART1_RX          | <b>ALT0:</b> UART1_RX<br><b>ALT1:</b> PWM1_OUT<br><b>ALT2:</b> GPT0_COMPARE<br><b>ALT3:</b> GPT1_CLK<br><b>ALT4:</b> GPIO0_IO22 | 3V3/3V3_RF  | Internal UART line used by the Bluetooth. This signal is externally available only in non-wireless variants. |

| LGA pad name | ConnectCore 8X signal name | i.MX 8X pad name* | Multiplexing                                                                                                                           | Power Group    | Comments                                                                                                     |
|--------------|----------------------------|-------------------|----------------------------------------------------------------------------------------------------------------------------------------|----------------|--------------------------------------------------------------------------------------------------------------|
| E13          | BT_UART1_TX                | UART1_TX          | <b>ALT0:</b> UART1_TX<br><b>ALT1:</b> PWM0_OUT<br><b>ALT2:</b> GPT0_CAPTURE<br><b>ALT3:</b><br><b>ALT4:</b> GPIO0_IO21                 | 3V3/3V3_RF     | Internal UART line used by the Bluetooth. This signal is externally available only in non-wireless variants. |
| E14          | VDD_ESAI_SPDIF             | -                 | -                                                                                                                                      | VDD_ESAI_SPDIF |                                                                                                              |
| E15          | GND                        | -                 | -                                                                                                                                      | -              |                                                                                                              |
| E16          | VDD_SPI_SAI                | -                 | -                                                                                                                                      | VDD_SPI_SAI    |                                                                                                              |
| E17          | SPI2_SCK                   | SPI2_SCK          | <b>ALT0:</b> SPI2_SCK<br><b>ALT1:</b><br><b>ALT2:</b><br><b>ALT3:</b><br><b>ALT4:</b> GPIO1_IO03                                       | VDD_SPI_SAI    |                                                                                                              |
| E18          | SPI0_SDO                   | SPI0_SDO          | <b>ALT0:</b> SPI0_SDO<br><b>ALT1:</b> SAI0_TXFS<br><b>ALT2:</b> M40_I2C0_SDA<br><b>ALT3:</b> M40_GPIO0_IO01<br><b>ALT4:</b> GPIO1_IO06 | VDD_SPI_SAI    |                                                                                                              |
| E19          | SPI0_CS0                   | SPI0_CS0          | <b>ALT0:</b> SPI0_CS0<br><b>ALT1:</b> SAI0_RXD<br><b>ALT2:</b> M40_TPM0_CH1<br><b>ALT3:</b> M40_GPIO0_IO03<br><b>ALT4:</b> GPIO1_IO08  | VDD_SPI_SAI    |                                                                                                              |

| LGA pad name | ConnectCore 8X signal name | i.MX 8X pad name* | Multiplexing                                                                                                                          | Power Group | Comments |
|--------------|----------------------------|-------------------|---------------------------------------------------------------------------------------------------------------------------------------|-------------|----------|
| E20          | SAI0_TXD                   | SAI0_TXD          | <b>ALT0:</b> SAI0_TXD<br><b>ALT1:</b> SAI1_RXC<br><b>ALT2:</b> SPI1_SDO<br><b>ALT3:</b> LCDIF_D18<br><b>ALT4:</b> GPIO0_IO25          | VDD_SPI_SAI |          |
| E21          | SAI0_RXD                   | SAI0_RXD          | <b>ALT0:</b> SAI0_RXD<br><b>ALT1:</b> SAI1_RXFS<br><b>ALT2:</b> SPI1_CS0<br><b>ALT3:</b> LCDIF_D20<br><b>ALT4:</b> GPIO0_IO27         | VDD_SPI_SAI |          |
| E22          | SPI0_SDI                   | SPI0_SDI          | <b>ALT0:</b> SPI0_SDI<br><b>ALT1:</b> SAI0_TXD<br><b>ALT2:</b> M40_TPM0_CH0<br><b>ALT3:</b> M40_GPIO0_IO02<br><b>ALT4:</b> GPIO1_IO05 | VDD_SPI_SAI |          |
| E23          | SAI0_TXC                   | SAI0_TXC          | <b>ALT0:</b> SAI0_TXC<br><b>ALT1:</b> SAI1_TXD<br><b>ALT2:</b> SPI1_SDI<br><b>ALT3:</b> LCDIF_D19<br><b>ALT4:</b> GPIO0_IO26          | VDD_SPI_SAI |          |
| E24          | SAI1_RXC                   | SAI1_RXC          | <b>ALT0:</b> SAI1_RXC<br><b>ALT1:</b> SAI1_TXC<br><b>ALT2:</b><br><b>ALT3:</b> LCDIF_D22<br><b>ALT4:</b> GPIO0_IO30                   | VDD_SPI_SAI |          |
| E25          | SAI1_RXFS                  | SAI1_RXFS         | <b>ALT0:</b> SAI1_RXFS<br><b>ALT1:</b> SAI1_TXFS<br><b>ALT2:</b><br><b>ALT3:</b> LCDIF_D23<br><b>ALT4:</b> GPIO0_IO31                 | VDD_SPI_SAI |          |

| LGA pad name | ConnectCore 8X signal name  | i.MX 8X pad name* | Multiplexing                                                                                                                  | Power Group         | Comments                                                                                                    |
|--------------|-----------------------------|-------------------|-------------------------------------------------------------------------------------------------------------------------------|---------------------|-------------------------------------------------------------------------------------------------------------|
| E26          | SPI0_CS1                    | SPI0_CS1          | <b>ALT0:</b> SPI0_CS1<br><b>ALT1:</b> SAI0_RXC<br><b>ALT2:</b> SAI1_TXD<br><b>ALT3:</b> LCDIF_PWM0<br><b>ALT4:</b> GPIO1_IO07 | VDD_SPI_SAI         |                                                                                                             |
| F2           | VDD_PCIE_DIG                | -                 | -                                                                                                                             | VDD_PCIE_DGI/3V3_RF |                                                                                                             |
| F4           | PCIE_LGA_OUT_CTRL0_WAKE_B   | -                 | <b>ALT0:</b> PCIE_CTRL0_WAKE_B<br><b>ALT4:</b> GPIO4_IO02                                                                     | VDD_PCIE_DIG        | Internal PCIe line used by the wireless. This signal is externally available only in non-wireless variants. |
| F5           | PCIE_LGA_OUT_CTRL0_CLKREQ_B | -                 | <b>ALT0:</b> PCIE_CTRL0_CLKREQ_B<br><b>ALT4:</b> GPIO4_IO01                                                                   | VDD_PCIE_DIG        | Internal PCIe line used by the wireless. This signal is externally available only in non-wireless variants. |

| LGA pad name | ConnectCore 8X signal name | i.MX 8X pad name* | Multiplexing                                               | Power Group  | Comments                                                                                                    |
|--------------|----------------------------|-------------------|------------------------------------------------------------|--------------|-------------------------------------------------------------------------------------------------------------|
| F6           | PCIE_LGA_OUT_CTRL0_PERST_B | -                 | <b>ALT0:</b> PCIE_CTRL0_PERST_B<br><b>ALT4:</b> GPIO4_IO00 | VDD_PCIE_DIG | Internal PCIe line used by the wireless. This signal is externally available only in non-wireless variants. |
| F7           | PCIE_LGA_IN_CTRL0_WAKE_B   | -                 | -                                                          | VDD_PCIE_DIG | Leave this pin floating unless otherwise noted.                                                             |
| F8           | PCIE_LGA_IN_CTRL0_CLKREQ_B | -                 | -                                                          | VDD_PCIE_DIG | Leave this pin floating unless otherwise noted.                                                             |
| F9           | PCIE_LGA_IN_CTRL0_PERST_B  | -                 | -                                                          | VDD_PCIE_DIG | Leave this pin floating unless otherwise noted.                                                             |

| LGA pad name | ConnectCore 8X signal name | i.MX 8X pad name* | Multiplexing                                                                                                                        | Power Group | Comments                                                                                                     |
|--------------|----------------------------|-------------------|-------------------------------------------------------------------------------------------------------------------------------------|-------------|--------------------------------------------------------------------------------------------------------------|
| F10          | 3V3_RF_EN                  | QSPI0A_DATA3      | <b>ALT0:</b> QSPI0A_DATA3<br><b>ALT4:</b> GPIO3_IO12                                                                                | 3V3         | In Wireless variants of the SOM this is a reserved output line. Do not drive this signal externally.         |
| F11          | BT_UART1_RTS#              | UART1_RTS_B       | <b>ALT0:</b> UART1_RTS_B<br><b>ALT1:</b> PWM2_OUT<br><b>ALT2:</b> LCDIF_D16<br><b>ALT3:</b> GPT1_CAPTURE<br><b>ALT4:</b> GPTO_CLK   | 3V3/3V3_RF  | Internal UART line used by the Bluetooth. This signal is externally available only in non-wireless variants. |
| F12          | BT_UART1_CTS#              | UART1_CTS_B       | <b>ALT0:</b> UART1_CTS_B<br><b>ALT1:</b> PWM3_OUT<br><b>ALT2:</b> LCDIF_D17<br><b>ALT3:</b> GPT1_COMPARE<br><b>ALT4:</b> GPIO0_IO24 | 3V3/3V3_RF  | Internal UART line used by the Bluetooth. This signal is externally available only in non-wireless variants. |
| F13          | PCM_OUT                    | -                 | -                                                                                                                                   | 3V3_RF      |                                                                                                              |
| F14          | PCM_SYNC                   | -                 | -                                                                                                                                   | 3V3_RF      |                                                                                                              |

| LGA pad name | ConnectCore 8X signal name | i.MX 8X pad name* | Multiplexing                                         | Power Group | Comments                                                                                              |
|--------------|----------------------------|-------------------|------------------------------------------------------|-------------|-------------------------------------------------------------------------------------------------------|
| F15          | GND                        | -                 | -                                                    | -           |                                                                                                       |
| F16          | GND                        | -                 | -                                                    | -           |                                                                                                       |
| F17          | 3V3_RF                     | -                 | -                                                    | 3V3_RF      |                                                                                                       |
| F18          | 3V3_RF                     | -                 | -                                                    | 3V3_RF      |                                                                                                       |
| F19          | RESERVED                   | -                 | -                                                    | -           |                                                                                                       |
| F20          | RESERVED                   | -                 | -                                                    | -           |                                                                                                       |
| F21          | GND                        | -                 | -                                                    | -           |                                                                                                       |
| F22          | GND                        | -                 | -                                                    | -           |                                                                                                       |
| F23          | QOW                        | -                 | -                                                    | 3V3_RF      |                                                                                                       |
| F24          | WLAN_LED                   | -                 | -                                                    | 3V3_RF      | Functionality not supported.                                                                          |
| F25          | BT_LED                     | -                 | -                                                    | 3V3_RF      | Functionality not supported.                                                                          |
| F26          | BT_EN                      | QSPI0A_DATA1      | <b>ALT0:</b> QSPI0A_DATA1<br><b>ALT4:</b> GPIO3_IO10 | 3V3_RF      | In wireless variants of the SOM, this is a reserved output line. Do not drive this signal externally. |

| LGA pad name | ConnectCore 8X signal name | i.MX 8X pad name* | Multiplexing                                         | Power Group | Comments                                                                                                    |
|--------------|----------------------------|-------------------|------------------------------------------------------|-------------|-------------------------------------------------------------------------------------------------------------|
| F27          | WL_EN                      | QSPI0A_DATA2      | <b>ALT0:</b> QSPI0A_DATA2<br><b>ALT4:</b> GPIO3_IO11 | 3V3_RF      | In wireless variants of the SOM, this is a reserved output line. Do not drive this signal externally.       |
| G3           | PCIE0_LGA_IN_REFCLK_N      | -                 | -                                                    | 1V          |                                                                                                             |
| G4           | PCIE0_LGA_IN_REFCLK_P      | -                 | -                                                    | 1V8         |                                                                                                             |
| G5           | GND                        | -                 | -                                                    | -           |                                                                                                             |
| G6           | PCIE0_LGA_OUT_RX0_N        | -                 | -                                                    | 1V8         | Internal PCIe line used by the Wireless. This signal is externally available only in non-wireless variants. |

| LGA pad name | ConnectCore 8X signal name | i.MX 8X pad name* | Multiplexing | Power Group | Comments                                                                                                    |
|--------------|----------------------------|-------------------|--------------|-------------|-------------------------------------------------------------------------------------------------------------|
| G7           | PCIE0_LGA_OUT_RX0_P        | -                 | -            | 1V8         | Internal PCIe line used by the Wireless. This signal is externally available only in non-wireless variants. |
| G8           | GND                        | -                 | -            | -           |                                                                                                             |
| G9           | PCIE0_LGA_OUT_TX0_N        | -                 | -            | 1V8         | Internal PCIe line used by the Wireless. This signal is externally available only in non-wireless variants. |
| G10          | PCIE0_LGA_OUT_TX0_P        | -                 | -            | 1V8         | Internal PCIe line used by the Wireless. This signal is externally available only in non-wireless variants. |

| LGA pad name | ConnectCore 8X signal name | i.MX 8X pad name* | Multiplexing | Power Group | Comments                                        |
|--------------|----------------------------|-------------------|--------------|-------------|-------------------------------------------------|
| G11          | GND                        | -                 | -            | -           |                                                 |
| G12          | BT_WAKEUP_SLAVE            | -                 | -            | 3V3_RF      |                                                 |
| G13          | PCM_CLK                    | -                 | -            | 3V3_RF      |                                                 |
| G14          | PCM_IN                     | -                 | -            | 3V3_RF      |                                                 |
| G15          | LTE_ACTIVE                 | -                 | -            | 3V3_RF      |                                                 |
| G16          | GND                        | -                 | -            | -           |                                                 |
| G17          | BT_WAKEUP_HOST             | -                 | -            | 3V3_RF      |                                                 |
| G18          | WLAN_SDIO_INT_L            | -                 | -            | 3V3_RF      |                                                 |
| G19          | GND                        | -                 | -            | -           |                                                 |
| G20          | PCIE0_LGA_IN_TX0_P         | -                 | -            | 1V8         | Leave this pin floating unless otherwise noted. |
| G21          | PCIE0_LGA_IN_TX0_N         | -                 | -            | 1V8         | Leave this pin floating unless otherwise noted. |
| G22          | GND                        | -                 | -            | -           |                                                 |
| G23          | PCIE0_LGA_IN_RX0_P         | -                 | -            | 1V8         | Leave this pin floating unless otherwise noted. |

| LGA pad name | ConnectCore 8X signal name | i.MX 8X pad name* | Multiplexing | Power Group | Comments                                        |
|--------------|----------------------------|-------------------|--------------|-------------|-------------------------------------------------|
| G24          | PCIE0_LGA_IN_RX0_N         | -                 | -            | 1V8         | Leave this pin floating unless otherwise noted. |
| G25          | GND                        | -                 | -            | -           |                                                 |
| G26          | GND                        | -                 | -            | -           |                                                 |
| G27          | GND                        | -                 | -            | -           |                                                 |
| G28          | GND                        | -                 | -            | -           |                                                 |
| H2           | GND                        | -                 | -            | -           |                                                 |
| H3           | GND                        | -                 | -            | -           |                                                 |
| H4           | GND                        | -                 | -            | -           |                                                 |
| H5           | GND                        | -                 | -            | -           |                                                 |
| H6           | GND                        | -                 | -            | -           |                                                 |
| H7           | GND                        | -                 | -            | -           |                                                 |
| H8           | GND                        | -                 | -            | -           |                                                 |
| H9           | GND                        | -                 | -            | -           |                                                 |
| H10          | GND                        | -                 | -            | -           |                                                 |
| H11          | GND                        | -                 | -            | -           |                                                 |
| H12          | GND                        | -                 | -            | -           |                                                 |
| H13          | GND                        | -                 | -            | -           |                                                 |
| H14          | GND                        | -                 | -            | -           |                                                 |

| LGA pad name | ConnectCore 8X signal name | i.MX 8X pad name* | Multiplexing | Power Group | Comments |
|--------------|----------------------------|-------------------|--------------|-------------|----------|
| H15          | GND                        | -                 | -            | -           |          |
| H16          | GND                        | -                 | -            | -           |          |
| H17          | GND                        | -                 | -            | -           |          |
| H18          | GND                        | -                 | -            | -           |          |
| H19          | GND                        | -                 | -            | -           |          |
| H20          | GND                        | -                 | -            | -           |          |
| H21          | GND                        | -                 | -            | -           |          |
| H22          | GND                        | -                 | -            | -           |          |
| H23          | GND                        | -                 | -            | -           |          |
| H24          | GND                        | -                 | -            | -           |          |
| H25          | GND                        | -                 | -            | -           |          |
| H26          | GND                        | -                 | -            | -           |          |
| H27          | GND                        | -                 | -            | -           |          |
| H28          | GND                        | -                 | -            | -           |          |
| AF2          | GND                        | -                 | -            | -           |          |
| AF3          | GND                        | -                 | -            | -           |          |
| AF4          | GND                        | -                 | -            | -           |          |
| AF5          | GND                        | -                 | -            | -           |          |
| AF6          | GND                        | -                 | -            | -           |          |
| AF7          | GND                        | -                 | -            | -           |          |

| LGA pad name | ConnectCore 8X signal name | i.MX 8X pad name* | Multiplexing | Power Group | Comments |
|--------------|----------------------------|-------------------|--------------|-------------|----------|
| AF8          | GND                        | -                 | -            | -           |          |
| AF9          | GND                        | -                 | -            | -           |          |
| AF10         | GND                        | -                 | -            | -           |          |
| AF11         | GND                        | -                 | -            | -           |          |
| AF12         | GND                        | -                 | -            | -           |          |
| AF13         | GND                        | -                 | -            | -           |          |
| AF14         | GND                        | -                 | -            | -           |          |
| AF15         | GND                        | -                 | -            | -           |          |
| AF16         | GND                        | -                 | -            | -           |          |
| AF17         | GND                        | -                 | -            | -           |          |
| AF18         | GND                        | -                 | -            | -           |          |
| AF19         | GND                        | -                 | -            | -           |          |
| AF20         | GND                        | -                 | -            | -           |          |
| AF21         | GND                        | -                 | -            | -           |          |
| AF22         | GND                        | -                 | -            | -           |          |
| AF23         | GND                        | -                 | -            | -           |          |
| AF24         | GND                        | -                 | -            | -           |          |
| AF25         | GND                        | -                 | -            | -           |          |
| AF26         | GND                        | -                 | -            | -           |          |
| AF27         | GND                        | -                 | -            | -           |          |

| LGA pad name | ConnectCore 8X signal name | i.MX 8X pad name* | Multiplexing                                                                                                                | Power Group | Comments |
|--------------|----------------------------|-------------------|-----------------------------------------------------------------------------------------------------------------------------|-------------|----------|
| AF28         | GND                        | -                 | -                                                                                                                           | -           |          |
| AG2          | GND                        | -                 | -                                                                                                                           | -           |          |
| AG3          | GND                        | -                 | -                                                                                                                           | -           |          |
| AG4          | GND                        | -                 | -                                                                                                                           | -           |          |
| AG5          | GND                        | -                 | -                                                                                                                           | -           |          |
| AG6          | GND                        | -                 | -                                                                                                                           | -           |          |
| AG7          | GND                        | -                 | -                                                                                                                           | -           |          |
| AG8          | QSPI0B_DATA3               | QSPI0B_DATA3      | <b>ALT0:</b> QSPI0B_DATA3<br><b>ALT1:</b> QSPI1A_DATA3<br><b>ALT2:</b> KPP0_ROW0<br><b>ALT3:</b><br><b>ALT4:</b> GPIO3_IO21 | VDD_QSPI0B  |          |
| AG9          | QSPI0B_DATA1               | QSPI0B_DATA1      | <b>ALT0:</b> QSPI0B_DATA1<br><b>ALT1:</b> QSPI1A_DATA1<br><b>ALT2:</b> KPP0_COL2<br><b>ALT3:</b><br><b>ALT4:</b> GPIO3_IO19 | VDD_QSPI0B  |          |
| AG10         | QSPI0B_SS1_B               | QSPI0B_SS1_B      | <b>ALT0:</b> QSPI0B_SS1_B<br><b>ALT1:</b> QSPI1A_SS1_B<br><b>ALT2:</b> KPP0_ROW3<br><b>ALT3:</b><br><b>ALT4:</b> GPIO3_IO24 | VDD_QSPI0B  |          |
| AG11         | QSPI0B_DATA0               | QSPI0B_DATA0      | <b>ALT0:</b> QSPI0B_DATA0<br><b>ALT1:</b> QSPI1A_DATA0<br><b>ALT2:</b> KPP0_COL1<br><b>ALT3:</b><br><b>ALT4:</b> GPIO3_IO18 | VDD_QSPI0B  |          |

| LGA pad name | ConnectCore 8X signal name | i.MX 8X pad name* | Multiplexing                                                                                                                | Power Group      | Comments                                                               |
|--------------|----------------------------|-------------------|-----------------------------------------------------------------------------------------------------------------------------|------------------|------------------------------------------------------------------------|
| AG12         | QSPI0B_DQS                 | QSPI0B_DQS        | <b>ALT0:</b> QSPI0B_DQS<br><b>ALT1:</b> QSPI1A_DQS<br><b>ALT2:</b> KPP0_ROW1<br><b>ALT3:</b><br><b>ALT4:</b> GPIO3_IO22     | VDD_QSPI0B       |                                                                        |
| AG13         | QSPI0B_SS0_B               | QSPI0B_SS0_B      | <b>ALT0:</b> QSPI0B_SS0_B<br><b>ALT1:</b> QSPI1A_SS0_B<br><b>ALT2:</b> KPP0_ROW2<br><b>ALT3:</b><br><b>ALT4:</b> GPIO3_IO23 | VDD_QSPI0B       |                                                                        |
| AG14         | QSPI0B_DATA2               | QSPI0B_DATA2      | <b>ALT0:</b> QSPI0B_DATA2<br><b>ALT1:</b> QSPI1A_DATA2<br><b>ALT2:</b> KPP0_COL3<br><b>ALT3:</b><br><b>ALT4:</b> GPIO3_IO20 | VDD_QSPI0B       |                                                                        |
| AG15         | QSPI0B_SCLK                | QSPI0B_SCLK       | <b>ALT0:</b> QSPI0B_SCLK<br><b>ALT1:</b> QSPI1A_SCLK<br><b>ALT2:</b> KPP0_COL0<br><b>ALT3:</b><br><b>ALT4:</b> GPIO3_IO17   | VDD_QSPI0B       |                                                                        |
| AG16         | GND                        | -                 | -                                                                                                                           | -                |                                                                        |
| AG17         | VDD_QSPI0B                 | -                 | -                                                                                                                           | VDD_QSPI0B       |                                                                        |
| AG18         | IMX8_ON_OFF                | ON_OFF_BUTTON     | -                                                                                                                           | VCC_SNVS_LDO_1V8 | ON/OFF signal from the CPU. Digi recommends leaving this pin floating. |
| AG19         | JTAG_TRST_GPIO             | JTAG_TRST_B       | -                                                                                                                           | VCC_SCU_1V8      |                                                                        |

| LGA pad name | ConnectCore 8X signal name | i.MX 8X pad name* | Multiplexing                                                                                                                          | Power Group | Comments |
|--------------|----------------------------|-------------------|---------------------------------------------------------------------------------------------------------------------------------------|-------------|----------|
| AG20         | JTAG_TCK                   | JTAG_TCK          | -                                                                                                                                     | VCC_SCU_1V8 |          |
| AG21         | JTAG_TDO                   | JTAG_TDO          | -                                                                                                                                     | VCC_SCU_1V8 |          |
| AG22         | VDD_CSI                    | -                 | -                                                                                                                                     | VDD_CSI     |          |
| AG23         | GND                        | -                 | -                                                                                                                                     | -           |          |
| AG24         | VDD_ADC_1V8                | -                 | -                                                                                                                                     | VDD_ADC_1V8 |          |
| AG25         | ADC_IN4                    | ADC_IN4           | <b>ALT0:</b> ADC_IN4<br><b>ALT1:</b> M40_TPM_CH0<br><b>ALT2:</b> M40_GPIO0_IO04<br><b>ALT3:</b><br><b>ALT4:</b> GPIO1_IO14            | 1V8         |          |
| AG26         | ADC_IN3                    | ADC_IN3           | <b>ALT0:</b> ADC_IN3<br><b>ALT1:</b> M40_UART0_TX<br><b>ALT2:</b> M40_GPIO0_IO03<br><b>ALT3:</b> MCLK_OUT0<br><b>ALT4:</b> GPIO1_IO11 | 1V8         |          |
| AG27         | ADC_IN2                    | ADC_IN2           | <b>ALT0:</b> ADC_IN2<br><b>ALT1:</b> M40_UART0_RX<br><b>ALT2:</b> M40_GPIO0_IO02<br><b>ALT3:</b> MCLK_IN0<br><b>ALT4:</b> GPIO1_IO12  | 1V8         |          |
| AG28         | ADC_IN5                    | ADC_IN5           | <b>ALT0:</b> ADC_IN5<br><b>ALT1:</b> TPM0_CH1<br><b>ALT2:</b> M40_GPIO0_IO05<br><b>ALT3:</b><br><b>ALT4:</b> GPIO1_IO13               | 1V8         |          |
| AH2          | 1V8                        | -                 | -                                                                                                                                     | 1V8         |          |
| AH3          | 1V8                        | -                 | -                                                                                                                                     | 1V8         |          |

| LGA pad name | ConnectCore 8X signal name | i.MX 8X pad name* | Multiplexing | Power Group       | Comments                                                                                                                    |
|--------------|----------------------------|-------------------|--------------|-------------------|-----------------------------------------------------------------------------------------------------------------------------|
| AH4          | GND                        | -                 | -            | -                 |                                                                                                                             |
| AH5          | GND                        | -                 | -            | -                 |                                                                                                                             |
| AH6          | PMIC_FSOB                  | -                 | -            |                   |                                                                                                                             |
| AH7          | LDO4                       | -                 | -            | LDO4              |                                                                                                                             |
| AH8          | GND                        | -                 | -            | -                 |                                                                                                                             |
| AH9          | LDO4IN                     | -                 | -            | -                 |                                                                                                                             |
| AH10         | POR_B                      | -                 | -            | VCC_SCU_1V8       | Reset signal of the CPU. Digi recommends leaving this pin floating. 10K pull-up inside the module connected to VCC_SCU_1V8. |
| AH11         | PMIC_EWARN                 | -                 | -            |                   |                                                                                                                             |
| AH12         | PMIC_WDI                   | -                 | -            |                   |                                                                                                                             |
| AH13         | VLDO2_VSELECT              | -                 | -            |                   |                                                                                                                             |
| AH14         | GND                        | -                 | -            | -                 |                                                                                                                             |
| AH15         | MIPI_DSI1_DATA2_P          | MIPI_DSI1_DATA2_P | -            | NVCC_MIPI_CSI_DSI |                                                                                                                             |
| AH16         | MIPI_DSI1_DATA2_N          | MIPI_DSI1_DATA2_N | -            | NVCC_MIPI_CSI_DSI |                                                                                                                             |

| LGA pad name | ConnectCore 8X signal name | i.MX 8X pad name* | Multiplexing                                                                                                                 | Power Group       | Comments |
|--------------|----------------------------|-------------------|------------------------------------------------------------------------------------------------------------------------------|-------------------|----------|
| AH17         | GND                        | -                 | -                                                                                                                            | -                 |          |
| AH18         | NVCC_MIPi_CSI_DSI          | -                 | -                                                                                                                            | NVCC_MIPi_CSI_DSI |          |
| AH19         | GND                        | -                 | -                                                                                                                            | -                 |          |
| AH20         | CSI_D06                    | CSI_D06           | <b>ALT0:</b> CSI_D08<br><b>ALT1:</b><br><b>ALT2:</b> SAI3_RXC<br><b>ALT3:</b> TAMPER_IN1<br><b>ALT4:</b>                     | VDD_CSI           |          |
| AH21         | GND                        | -                 | -                                                                                                                            | -                 |          |
| AH22         | CSI_PCLK                   | CSI_PCLK          | <b>ALT0:</b> CSI_PCLK<br><b>ALT1:</b> MIPi_CSI0_I2C0_SCL<br><b>ALT2:</b><br><b>ALT3:</b> SPI1_SCK<br><b>ALT4:</b> GPIO3_IO00 | VDD_CSI           |          |
| AH23         | CSI_VSYNC                  | CSI_VSYNC         | <b>ALT0:</b> CSI_VSYNC<br><b>ALT1:</b> CSI_D01<br><b>ALT2:</b><br><b>ALT3:</b> TAMPER_IN4<br><b>ALT4:</b>                    | VDD_CSI           |          |
| AH24         | CSI_D03                    | CSI_D03           | <b>ALT0:</b> CSI_D05<br><b>ALT1:</b><br><b>ALT2:</b> SAI2_RXC<br><b>ALT3:</b> TAMPER_OUT3<br><b>ALT4:</b>                    | VDD_CSI           |          |
| AH25         | CSI_D00                    | CSI_D00           | <b>ALT0:</b> CSI_D02<br><b>ALT1:</b><br><b>ALT2:</b> SAI0_RXC<br><b>ALT3:</b> TAMPER_OUT0<br><b>ALT4:</b>                    | VDD_CSI           |          |

| LGA pad name | ConnectCore 8X signal name | i.MX 8X pad name* | Multiplexing                                                                                              | Power Group | Comments |
|--------------|----------------------------|-------------------|-----------------------------------------------------------------------------------------------------------|-------------|----------|
| AH26         | CSI_D01                    | CSI_D01           | <b>ALT0:</b> CSI_D03<br><b>ALT1:</b><br><b>ALT2:</b> SAI0_RXD<br><b>ALT3:</b> TAMPER_OUT1<br><b>ALT4:</b> | VDD_CSI     |          |
| AH27         | JTAG_TDI                   | JTAG_TDI          | -                                                                                                         | VCC_SCU_1V8 |          |
| AH28         | JTAG_TMS                   | JTAG_TMS          | -                                                                                                         | VCC_SCU_1V8 |          |
| AJ2          | VSYS2                      | -                 | -                                                                                                         | VSYS2       |          |
| AJ3          | VSYS2                      | -                 | -                                                                                                         | VSYS2       |          |
| AJ4          | VSYS2                      | -                 | -                                                                                                         | VSYS2       |          |
| AJ5          | GND                        | -                 | -                                                                                                         | -           |          |
| AJ6          | GND                        | -                 | -                                                                                                         | -           |          |
| AJ7          | GND                        | -                 | -                                                                                                         | -           |          |
| AJ8          | LDO3IN                     | -                 | -                                                                                                         |             |          |
| AJ9          | GND                        | -                 | -                                                                                                         | -           |          |
| AJ10         | LDO3                       | -                 | -                                                                                                         | LDO3        |          |
| AJ11         | SCU_PMIC_STANDBY           | -                 | -                                                                                                         |             |          |

| LGA pad name | ConnectCore 8X signal name | i.MX 8X pad name* | Multiplexing | Power Group       | Comments                                                                                                                                                                           |
|--------------|----------------------------|-------------------|--------------|-------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| AJ12         | PWR_ON                     | -                 | -            |                   | Power on/off signal of the SOM:<br><br><ul style="list-style-type: none"> <li>■ ON: high level.</li> <li>■ OFF: low level.</li> </ul> 2.2M pull-up on module connected to VCC_MCA. |
| AJ13         | VCC_SNVLS_LDO_1V8          | -                 | -            | VCC_SNVLS_LDO_1V8 | Do not use this cell unless otherwise noted.                                                                                                                                       |
| AJ14         | GND                        | -                 | -            | -                 |                                                                                                                                                                                    |
| AJ15         | MIPI_DSI1_DATA0_N          | MIPI_DSI1_DATA0_N | -            | NVCC_MIPI_CSI_DSI |                                                                                                                                                                                    |
| AJ16         | MIPI_DSI1_DATA0_P          | MIPI_DSI1_DATA0_P | -            | NVCC_MIPI_CSI_DSI |                                                                                                                                                                                    |
| AJ17         | GND                        | -                 | -            | -                 |                                                                                                                                                                                    |
| AJ18         | MIPI_DSI1_CLK_P            | MIPI_DSI1_CLK_P   | -            | NVCC_MIPI_CSI_DSI |                                                                                                                                                                                    |
| AJ19         | MIPI_DSI1_CLK_N            | MIPI_DSI1_CLK_N   | -            | NVCC_MIPI_CSI_DSI |                                                                                                                                                                                    |
| AJ20         | GND                        | -                 | -            | -                 |                                                                                                                                                                                    |

| LGA pad name | ConnectCore 8X signal name | i.MX 8X pad name* | Multiplexing                                                                                                                 | Power Group | Comments |
|--------------|----------------------------|-------------------|------------------------------------------------------------------------------------------------------------------------------|-------------|----------|
| AJ21         | CSI_MCLK                   | CSI_MCLK          | <b>ALT0:</b> CSI_MCLK<br><b>ALT1:</b> MIPI_CSI0_I2C0_SDA<br><b>ALT2:</b><br><b>ALT3:</b> SPI1_SDO<br><b>ALT4:</b> GPIO3_IO01 | VDD_CSI     |          |
| AJ22         | CSI_D07                    | CSI_D07           | <b>ALT0:</b> CSI_D09<br><b>ALT1:</b><br><b>ALT2:</b> SAI3_RXD<br><b>ALT3:</b> TAMPER_IN2<br><b>ALT4:</b>                     | VDD_CSI     |          |
| AJ23         | CSI_D04                    | CSI_D04           | <b>ALT0:</b> CSI_D06<br><b>ALT1:</b><br><b>ALT2:</b> SAI2_RXD<br><b>ALT3:</b> TAMPER_OUT4<br><b>ALT4:</b>                    | VDD_CSI     |          |
| AJ24         | CSI_D05                    | CSI_D05           | <b>ALT0:</b> CSI_D07<br><b>ALT1:</b><br><b>ALT2:</b> SAI2_RXFS<br><b>ALT3:</b> TAMPER_IN0<br><b>ALT4:</b>                    | VDD_CSI     |          |
| AJ25         | CSI_D02                    | CSI_D02           | <b>ALT0:</b> CSI_D04<br><b>ALT1:</b><br><b>ALT2:</b> SAI0_RXFS<br><b>ALT3:</b> TAMPER_OUT2<br><b>ALT4:</b>                   | VDD_CSI     |          |
| AJ26         | GND                        | -                 | -                                                                                                                            | -           |          |
| AJ27         | SCU_BOOT_MODE3             | SCU_BOOT_MODE3    | -                                                                                                                            | VCC_SCU_1V8 |          |
| AJ28         | SCU_BOOT_MODE2             | SCU_BOOT_MODE2    | -                                                                                                                            | VCC_SCU_1V8 |          |
| AK2          | VSYS2                      | -                 | -                                                                                                                            | VSYS2       |          |

| LGA pad name | ConnectCore 8X signal name | i.MX 8X pad name* | Multiplexing | Power Group       | Comments |
|--------------|----------------------------|-------------------|--------------|-------------------|----------|
| AK3          | VSYS2                      | -                 | -            | VSYS2             |          |
| AK4          | VSYS2                      | -                 | -            | VSYS2             |          |
| AK5          | GND                        | -                 | -            | -                 |          |
| AK6          | GND                        | -                 | -            | -                 |          |
| AK7          | GND                        | -                 | -            | -                 |          |
| AK8          | GND                        | -                 | -            | -                 |          |
| AK9          | GND                        | -                 | -            | -                 |          |
| AK10         | GND                        | -                 | -            | -                 |          |
| AK11         | GND                        | -                 | -            | -                 |          |
| AK12         | GND                        | -                 | -            | -                 |          |
| AK13         | GND                        | -                 | -            | -                 |          |
| AK14         | GND                        | -                 | -            | -                 |          |
| AK15         | MIPI_DSI1_DATA1_N          | MIPI_DSI1_DATA1_N | -            | NVCC_MIPI_CSI_DSI |          |
| AK16         | MIPI_DSI1_DATA1_P          | MIPI_DSI1_DATA1_P | -            | NVCC_MIPI_CSI_DSI |          |
| AK17         | GND                        | -                 | -            | -                 |          |
| AK18         | MIPI_DSI1_DATA3_P          | MIPI_DSI1_DATA3_P | -            | NVCC_MIPI_CSI_DSI |          |
| AK19         | MIPI_DSI1_DATA3_N          | MIPI_DSI1_DATA3_N | -            | NVCC_MIPI_CSI_DSI |          |
| AK20         | GND                        | -                 | -            | -                 |          |
| AK21         | MIPI_CSI0_DATA3_P          | MIPI_CSI0_DATA3_P | -            | NVCC_MIPI_CSI_DSI |          |
| AK22         | MIPI_CSI0_DATA3_N          | MIPI_CSI0_DATA3_N | -            | NVCC_MIPI_CSI_DSI |          |

| LGA pad name | ConnectCore 8X signal name | i.MX 8X pad name*  | Multiplexing                                                                                                                    | Power Group | Comments |
|--------------|----------------------------|--------------------|---------------------------------------------------------------------------------------------------------------------------------|-------------|----------|
| AK23         | GND                        | -                  | -                                                                                                                               | -           |          |
| AK24         | MIPI_CSI0_I2C0_SDA         | MIPI_CSI0_I2C0_SDA | <b>ALT0:</b> MIPI_CSI0_I2C0_SDA<br><b>ALT1:</b> MIPI_CSI0_GPIO0_IO03<br><b>ALT2:</b><br><b>ALT3:</b><br><b>ALT4:</b> GPIO3_IO06 | 1V8         |          |
| AK25         | MIPI_CSI0_I2C0_SCL         | MIPI_CSI0_I2C0_SCL | <b>ALT0:</b> MIPI_CSI0_I2C0_SCL<br><b>ALT1:</b> MIPI_CSI0_GPIO0_IO02<br><b>ALT2:</b><br><b>ALT3:</b><br><b>ALT4:</b> GPIO3_IO05 | 1V8         |          |
| AK26         | CSI_RESET                  | CSI_RESET          | <b>ALT0:</b> CSI_RESET<br><b>ALT1:</b> CSI_I2C_SDA<br><b>ALT2:</b> I2C3_SDA<br><b>ALT3:</b> SPI1_CS0<br><b>ALT4:</b> GPIO3_IO03 | VDD_CSI     |          |
| AK27         | CSI_EN                     | CSI_EN             | <b>ALT0:</b> CSI_EN<br><b>ALT1:</b> CSI_I2C_SCL<br><b>ALT2:</b> I2C3_SCL<br><b>ALT3:</b> SPI1_SDI<br><b>ALT4:</b> GPIO3_IO02    | VDD_CSI     |          |
| AK28         | CSI_HSYNC                  | CSI_HSYNC          | <b>ALT0:</b> CSI_HSYNC<br><b>ALT1:</b> CSI_D00<br><b>ALT2:</b> SAI3_RXFS<br><b>ALT3:</b> TAMPER_IN3<br><b>ALT4:</b>             | VDD_CSI     |          |
| AL2          | 3V3                        | -                  | -                                                                                                                               | 3V3         |          |

| LGA pad name | ConnectCore 8X signal name | i.MX 8X pad name*  | Multiplexing                                                                                               | Power Group       | Comments |
|--------------|----------------------------|--------------------|------------------------------------------------------------------------------------------------------------|-------------------|----------|
| AL3          | 3V3                        | -                  | -                                                                                                          | 3V3               |          |
| AL4          | GND                        | -                  | -                                                                                                          | -                 |          |
| AL5          | GND                        | -                  | -                                                                                                          | -                 |          |
| AL6          | VSYS                       | -                  | -                                                                                                          | VSYS              |          |
| AL7          | VSYS                       | -                  | -                                                                                                          | VSYS              |          |
| AL8          | VSYS                       | -                  | -                                                                                                          | VSYS              |          |
| AL9          | GND                        | -                  | -                                                                                                          | -                 |          |
| AL10         | GND                        | -                  | -                                                                                                          | -                 |          |
| AL11         | GND                        | -                  | -                                                                                                          | -                 |          |
| AL12         | MIPI_CSI0_DATA1_P          | MIPI_CSI0_DATA1_P  | -                                                                                                          | NVCC_MIPI_CSI_DSI |          |
| AL13         | MIPI_CSI0_DATA1_N          | MIPI_CSI0_DATA1_N  | -                                                                                                          | NVCC_MIPI_CSI_DSI |          |
| AL14         | GND                        | -                  | -                                                                                                          | -                 |          |
| AL15         | MIPI_CSI0_DATA0_P          | MIPI_CSI0_DATA0_P  | -                                                                                                          | NVCC_MIPI_CSI_DSI |          |
| AL16         | MIPI_CSI0_DATA0_N          | MIPI_CSI0_DATA0_N  | -                                                                                                          | NVCC_MIPI_CSI_DSI |          |
| AL17         | GND                        | -                  | -                                                                                                          | -                 |          |
| AL18         | MIPI_CSI0_MCLK_OUT         | MIPI_CSI0_MCLK_OUT | <b>ALT0:</b> MIPI_CSI0_MCLK_OUT<br><b>ALT1:</b><br><b>ALT2:</b><br><b>ALT3:</b><br><b>ALT4:</b> GPIO3_IO04 | 1V8               |          |
| AL19         | RESERVED                   | -                  | -                                                                                                          | -                 |          |
| AL20         | RESERVED                   | -                  | -                                                                                                          | -                 |          |

| LGA pad name | ConnectCore 8X signal name | i.MX 8X pad name* | Multiplexing                                                                                                                                                                                  | Power Group | Comments |
|--------------|----------------------------|-------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|----------|
| AL21         | MCA_CLKOUT32K              | -                 | <b>ALT0:</b><br><b>ALT1:</b> PTE0/CLKOUT32K<br><b>ALT2:</b> SPI1_MISO<br><b>ALT3:</b> LPUART1_TX<br><b>ALT4:</b> RTC_CLKOUT<br><b>ALT5:</b> CMP0_OUT<br><b>ALT6:</b> I2C1_SDA<br><b>ALT7:</b> | VCC_MCA     |          |
| AL22         | MCA_IO13                   | -                 | <b>ALT0:</b><br><b>ALT1:</b> PTD7<br><b>ALT2:</b> SPI1_MISO<br><b>ALT3:</b> LPUART0_TX<br><b>ALT4:</b> I2C1_SCL<br><b>ALT5:</b> SPI1_MOSI<br><b>ALT6:</b> FXIO0_D7<br><b>ALT7:</b>            | VCC_MCA     |          |
| AL23         | MCA_IO17                   | -                 | <b>ALT0:</b><br><b>ALT1:</b> PTD4/LLWU_P14<br><b>ALT2:</b> SPI1_PCS0<br><b>ALT3:</b> UART2_RX<br><b>ALT4:</b> TPM0_CH4<br><b>ALT5:</b><br><b>ALT6:</b> FXIO0_D4<br><b>ALT7:</b>               | VCC_MCA     |          |
| AL24         | MCA_IO16                   | -                 | <b>ALT0:</b><br><b>ALT1:</b> PTC4/LLWU_P8<br><b>ALT2:</b> SPI0_PCS0<br><b>ALT3:</b> LPUART1_TX<br><b>ALT4:</b> TPM0_CH3<br><b>ALT5:</b> SPI1_PCS0<br><b>ALT6:</b><br><b>ALT7:</b>             | VCC_MCA     |          |

| LGA pad name | ConnectCore 8X signal name | i.MX 8X pad name* | Multiplexing                                                                                                                                                          | Power Group | Comments |
|--------------|----------------------------|-------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|----------|
| AL25         | MCA_IO15                   | -                 | <b>ALT0:</b><br><b>ALT1:</b> PTC3<br><b>ALT2:</b> SPI1_SCK<br><b>ALT3:</b> LPUART1_RX<br><b>ALT4:</b> TPM0_CH2<br><b>ALT5:</b> CLKOUT<br><b>ALT6:</b><br><b>ALT7:</b> | VCC_MCA     |          |
| AL26         | MCA_IO14                   | -                 | <b>ALT0:</b> ADC0_SE11<br><b>ALT1:</b> PTC2<br><b>ALT2:</b> I2C1_SDA<br><b>ALT3:</b><br><b>ALT4:</b> TPM0_CH1<br><b>ALT5:</b><br><b>ALT6:</b><br><b>ALT7:</b>         | VCC_MCA     |          |
| AM3          | 3V3                        | -                 | -                                                                                                                                                                     | 3V3         |          |
| AM4          | 3V3                        | -                 | -                                                                                                                                                                     | 3V3         |          |
| AM5          | GND                        | -                 | -                                                                                                                                                                     | -           |          |
| AM6          | GND                        | -                 | -                                                                                                                                                                     | -           |          |
| AM7          | PMIC_PGOOD                 | -                 | -                                                                                                                                                                     |             |          |
| AM8          | VCC_LICELL                 | -                 | -                                                                                                                                                                     | VCC_LICELL  |          |
| AM9          | PMIC_AMUX                  | -                 | -                                                                                                                                                                     |             |          |
| AM10         | RESERVED                   | -                 | -                                                                                                                                                                     | -           |          |
| AM11         | RESERVED                   | -                 | -                                                                                                                                                                     | -           |          |
| AM12         | GND                        | -                 | -                                                                                                                                                                     | -           |          |

| LGA pad name | ConnectCore 8X signal name | i.MX 8X pad name* | Multiplexing                                                                                                                                                                                          | Power Group       | Comments |
|--------------|----------------------------|-------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|----------|
| AM13         | MIPI_CSI0_CLK_P            | MIPI_CSI0_CLK_P   | -                                                                                                                                                                                                     | NVCC_MIPI_CSI_DSI |          |
| AM14         | MIPI_CSI0_CLK_N            | MIPI_CSI0_CLK_N   | -                                                                                                                                                                                                     | NVCC_MIPI_CSI_DSI |          |
| AM15         | GND                        | -                 | -                                                                                                                                                                                                     | -                 |          |
| AM16         | MIPI_CSI0_DATA2_P          | MIPI_CSI0_DATA2_P | -                                                                                                                                                                                                     | NVCC_MIPI_CSI_DSI |          |
| AM17         | MIPI_CSI0_DATA2_N          | MIPI_CSI0_DATA2_N | -                                                                                                                                                                                                     | NVCC_MIPI_CSI_DSI |          |
| AM18         | GND                        | -                 | -                                                                                                                                                                                                     | -                 |          |
| AM19         | RESERVED                   | -                 | -                                                                                                                                                                                                     | -                 |          |
| AM20         | GND                        | -                 | -                                                                                                                                                                                                     | -                 |          |
| AM21         | VCC_MCA                    | -                 | -                                                                                                                                                                                                     | VCC_MCA           |          |
| AM22         | RESERVED                   | -                 | -                                                                                                                                                                                                     | -                 |          |
| AM23         | MCA_IO18                   | -                 | <b>ALT0:</b> ADC0_SE7b<br><b>ALT1:</b> PTD6/LLWU_P15<br><b>ALT2:</b> SPI1_MOSI<br><b>ALT3:</b> LPUART0_RX<br><b>ALT4:</b> I2C1_SDA<br><b>ALT5:</b> SPI1_MISO<br><b>ALT6:</b> FXIO0_D6<br><b>ALT7:</b> | VCC_MCA           |          |
| AM24         | MCA_VREF_OUT               | -                 |                                                                                                                                                                                                       | VCC_MCA           |          |

| LGA pad name | ConnectCore 8X signal name | i.MX 8X pad name* | Multiplexing                                                                                                                                                                             | Power Group | Comments |
|--------------|----------------------------|-------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|----------|
| AM25         | MCA_IO12                   | -                 | <b>ALT0:</b> ADC0_SE9<br><b>ALT1:</b> PTB1<br><b>ALT2:</b> I2C0_SDA<br><b>ALT3:</b> TPM1_CH1<br><b>ALT4:</b> SPI1_MISO<br><b>ALT5:</b> SPI1_MOSI<br><b>ALT6:</b><br><b>ALT7:</b>         | VCC_MCA     |          |
| AM26         | MCA_IO11                   | -                 | <b>ALT0:</b> ADC0_SE8<br><b>ALT1:</b> PTB0/LLWU_P5<br><b>ALT2:</b> I2C0_SCL<br><b>ALT3:</b> TPM1_CH0<br><b>ALT4:</b> SPI1_MOSI<br><b>ALT5:</b> SPI1_MISO<br><b>ALT6:</b><br><b>ALT7:</b> | VCC_MCA     |          |



**CAUTION!** All WLAN\_SD1 pads must remain unconnected unless you have a variant carrying a wireless MAC that uses an SDIO interface.

# Module specifications

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The following sections describe the specifications for the ConnectCore 8X System-on-module.

Power consumption .....98

Environmental specifications .....100

## Power consumption

This section contains information about the power consumption of the ConnectCore 8X System-on-module. All measurements were performed on the ConnectCore 8X SBC platform running Digi Embedded Yocto.

All presented results were measured at ambient temperature (25°C).

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**Note** These power consumption numbers should be considered guidelines only, never as fixed or absolute values. Actual values will depend entirely upon individual setup and system application.

---

### Power consumption use cases

The power consumption of the ConnectCore 8X System-on-module was evaluated in the following use cases:

#### ***KS0 - Power off mode***

Long-term power off state. In this mode, the power-on key can be asserted to start the device. Resumption is done via a full reboot.

You can enter this mode by issuing the following command:

---

```
~# poweroff
```

---

#### ***KS1 - Standby mode***

Low power mode state that allows system restart without a full reboot. The logic state of the system is stored in RAM, which stays in self-refresh state. Resumption is done via a wake-up event, which causes the system to perform a warm boot.

You can enter this mode by issuing the following command:

---

```
~# standby
```

---

#### ***KS2 - System idle***

System stays in Idle mode:

- Linux is alive but idle, waiting for an event. CPU is halted waiting for interrupt.
- Only one CPU core is enabled.
- The GPU is not working.
- Screens are off so no significant I/O to DDR is occurring.

#### ***KS3 - User Idle mode***

Fully loaded and running OS, with an active display waiting for a command on the UI with the following conditions:

- Linux is operating.
- GPU and CPU complexes are powered but in IDLE state
- 10" display is on.

### Complex power consumption use cases

The following use cases define real scenarios where CPU and GPU are stressed:

### CoreMark & Dhrystone

CoreMark and Dhrystone are benchmark tools that measure the performance of central processing units (CPU) in embedded systems.

### GLMARK2

Glmark2 is a benchmark tool that measures many aspects of OpenGL (ES) 2.0 performance.

### Dual Video Play

The Dual Video Play benchmark tool measures the performance of the system when displaying video through both LVDS.

## Results

ConnectCore 8X - 2GB RAM- 16GB eMMC

| State           | SOM consumption <sup>1</sup><br>(mW) | Full SBC consumption <sup>2</sup><br>(mW) | Benchmark result      |
|-----------------|--------------------------------------|-------------------------------------------|-----------------------|
| KS0             | 1.1                                  | 16.5                                      | -                     |
| KS1             | 35                                   | 40                                        | -                     |
| KS2             | 1100                                 | 1850                                      | -                     |
| KS3             | 2085                                 | 5750                                      | -                     |
| CoreMark        | 1600                                 | 2600                                      | 13972.985561 iter/sec |
| GLMARK2         | *                                    | 9000                                      | 743                   |
| Dual Video Play | *                                    | 12000                                     | -                     |

<sup>1</sup> Measured at R1 on the SBC (input of VSYS+VSYS2)

<sup>2</sup> Measured at the 5V input barrel connector. Note that the power consumption measurements on the SBC include all the interfaces available on this platform. It also includes the power consumption of the lvds displays, when used.

\* Due to hardware requirements, this consumption cannot be obtained for the SOM alone.

## Environmental specifications

- Operating temperature: -40 to 85 C.
- 



**CAUTION!** Your final product may require additional thermal management such as passive (heatsink/spreader) or active (airflow) cooling to achieve the maximum operating temperature without exceeding the processor junction temp limit.

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- The ConnectCore 8X module shall be built in an enclosure so the shield is not accessible to the end user.

## Assembly instructions

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## Moisture sensitivity and shelf life

The ConnectCore 8X system-on-module module is classified as a Level 3 Moisture Sensitive Device in accordance with IPC/JEDEC J-STD-020.

1. Calculated shelf life in sealed packaging: 12 months at <40°C and <90% relative humidity (RH).
2. Environmental condition during production: 30°C / 60% RH according to IPC/JEDEC J-STD-033C paragraph 5.
3. After module is removed from sealed packaging, modules that will be subjected to reflow solder temperatures are required to be:
  - a. Mounted within 168 hours
  - b. Stored per J-STD-033
4. Baking is required, before mounting if:
  - a. the packaging humidity indicator indicates 10% RH or higher.
  - b. either 3a or 3b are not met
5. If baking is required, bake modules in trays for 4-6 hours at 125°C; maximum stacking height is 10 trays.

## Mounting

The ConnectCore 8X system-on-module module has been designed with easy integration into existing SMT processes in mind. This section contains guidance for mounting the module on your carrier board.

Modules are not sealed and therefore they should not be subjected to a wash cycle or similar treatment where condensation could occur. Contact Digi International for guidance to discuss conformal coating approaches and options, if needed.

## Coplanarity

The coplanarity measured is <0.003" bow and twist (98% confidence interval). It is important that the carrier board is also coplanar. It is recommended that the assembly be supported during the reflow process with a fixture to minimize the potential bow of the carrier card.

## Solder paste print

The following solder paste type has been approved for mounting the module on a carrier board:

- SAC305 No-Clean solder paste (Lead-free: Alpha OM-340 Type 4 or equivalent)

The following solder paste printing parameters are recommended:

- Stencil thickness: 0.125 mm/5 mil
- Stencil diameter: One to one of pad diameter (to +20% of pad)
- Paste alignment: 20% off the pad max (offset <20% pad diameter)

## Stencil

The recommendation is to use a laser cut and/or electro-formed stencil. Based on the actual coplanarity characteristics of your carrier board, adjustments may be required to determine the optimal solder paste volume.

## SMT pick and place

- Placement nozzle: Largest available on the machine
- Nozzle pick surface: Center of shield
- Placement speed: Slowest speed for the machine
- Placement alignment: 10% of pad diameter (compensating for module weight and supporting alignment). The module should be placed last as part of the assembly/mounting process to eliminate unexpected shifting.

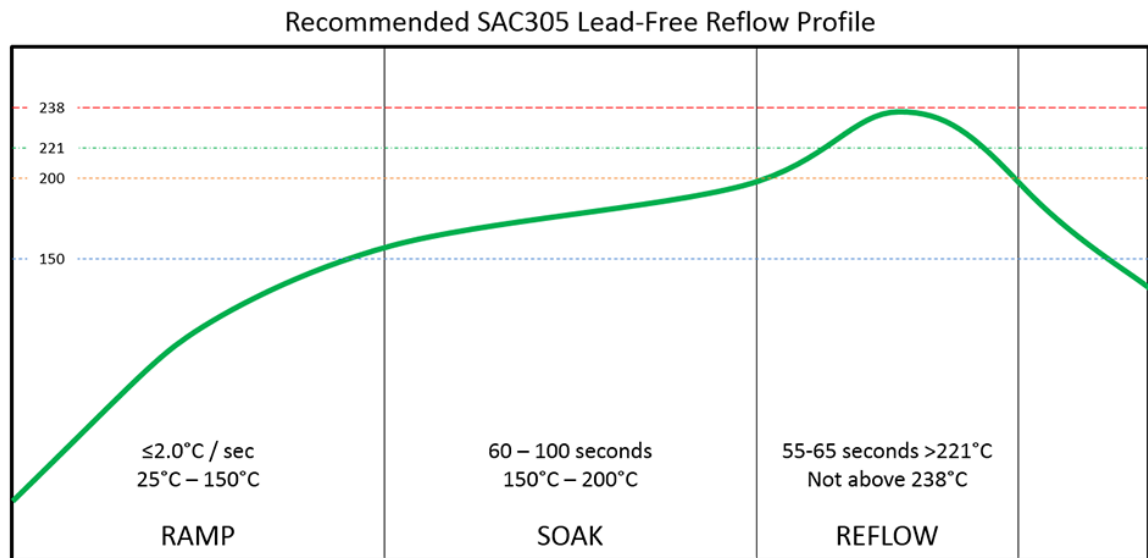
## SMT process parameter reference

| Process      | SMT process                            | Specification recommendations                |
|--------------|----------------------------------------|----------------------------------------------|
| Screen print | Solder paste                           | SAC305 No-Clean (Alpha OM-340 or equivalent) |
|              | Stencil thickness                      | 0.15 mm / 5 mil                              |
|              | Stencil diameter                       | 1.47 mm / 58mil                              |
|              | Paste alignment                        | 20% maximum off center of the pad            |
| PnP          | Placement nozzle                       | Largest available on machine                 |
|              | Nozzle pick surface                    | Shield center                                |
|              | Speed                                  | Slowest possible with PnP machine            |
|              | Placement sequence                     | Last, if possible                            |
|              | Placement alignment                    | 10% maximum off center of pad                |
| Reflow       | See the <a href="#">Reflow profile</a> |                                              |

## Reflow profile

Digi recommends the following:

- SoM temperature below 238°C during reflow cycle.
- Time Above Liquidus (TAL) between 55 and 65 seconds.
- Use of 40AWG K-type thermal couple and M.O.L.E. or equivalent thermal profiler.



Recommended reflow profile only - 10 heating zone convection reflow oven  
Modifications to profile may be required to fit specific equipment, application, process or design

Digi recommends you use two (2) thermocouple locations to achieve proper attachment of SoM:

- Attach thermocouple to bottom of SoM located in the center of the cutout with the thermocouple touching the SoM.
- Drill hole through bottom of carrier PCB near corner of SoM deep enough to reach SoM.
- Insert thermocouple into hole touching SoM and secure.

Digi recommends X-ray analysis after reflow to confirm proper mounting and solder reflow.

The ConnectCore 8X system-on-module is approved to withstand a total of four (4) reflow cycles. Two (2) reflow cycles are required for manufacturing the module. Two (2) reflow cycles are remaining for mounting the module on the carrier board. Digi strongly recommends soldering the module during the last reflow cycles of the carrier board manufacturing process.

# Regulatory information and certifications

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**Note** The ConnectCore 8X module complies with Part 15 of the United States FCC rules and regulations. Other certifications are currently pending.

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## United States FCC

The ConnectCore 8X module complies with Part 15 of the FCC rules and regulations. Compliance with the labeling requirements, FCC notices and antenna usage guidelines is required. To fulfill FCC Certification, the OEM must comply with the following regulations:

The system integrator must ensure that the text on top side of the module is placed on the outside of the final product.

ConnectCore 8X module may only be used with antennas approved (see [Approved antennas](#)).

### Labeling requirements



**WARNING!** The Original Equipment Manufacturer (OEM) must ensure that FCC labeling requirements are met. This includes a clearly visible label on the outside of the final product enclosure that displays the contents shown below. Required FCC Label for OEM products containing the ConnectCore 8X module.

#### Contains FCC ID: MCQ-CCIMX8

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

### Maximum power and frequency specifications (FCC)

| RF band | Peak antenna gain | Technology   | Frequencies                                                                                                     |
|---------|-------------------|--------------|-----------------------------------------------------------------------------------------------------------------|
| 2.4 GHz | 2.5 dBi           | BT + EDR     | [BW 1 MHz] x 79 non-overlapping channels, # (center freq. MHz): *<br>[2400 - 2483.5 MHz]: 0 (2402) to 78 (2480) |
|         |                   | Bluetooth LE | [BW 2 MHz] x 40 non-overlapping channels, # (center freq. MHz): *<br>[2400 - 2483.5 MHz]: 0 (2402) to 39 (2480) |

| RF band | Peak antenna gain | Technology | Frequencies                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|---------|-------------------|------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2.4 GHz | 4.6 dBi           | WLAN       | [BW 20 MHz] x 11 overlapping channels, # (center freq. MHz): *<br>[2400 - 2473 MHz]: 1 (2412), 2 (2417), 3 (2422), 4 (2427), 5 (2432), 6 (2437), 7 (2442), 8 (2447), 9 (2452), 10 (2457), 11 (2462)                                                                                                                                                                                                                                                 |
|         |                   |            | [BW 40 MHz] x 7 overlapping channels, # (center freq. MHz): *<br>[2400 - 2473 MHz]: 3 (2422), 4 (2427), 5 (2432), 6 (2437), 7 (2442), 8 (2447), 9 (2452)                                                                                                                                                                                                                                                                                            |
|         |                   |            | [BW 20 MHz] x 24 non-overlapping channels, # (center freq. MHz): *<br>* [5150 - 5250 MHz]: 36 (5180), 40 (5200), 44 (5220), 48 (5240) *<br>[5250 - 5350 MHz]: 52 (5260), 56 (5280), 60 (5300), 64 (5320) *<br>[5470 - 5725 MHz]: 100 (5500), 104 (5520), 108 (5540), 112 (5560), 116 (5580), 120 (5600), 124 (5620), 128 (5640), 132 (5660), 136 (5680), 140 (5700) * [5725 - 5850 MHz]: 149 (5745), 153 (5765), 157 (5785), 161 (5805), 165 (5825) |
|         |                   |            | [BW 40 MHz] x 11 non-overlapping channels, # (center freq. MHz): *<br>* [5150 - 5250 MHz]: 38 (5190), 46 (5230) * [5250 - 5350 MHz]: 54 (5270), 62 (5310) * [5470 - 5725 MHz]: 102 (5510), 110 (5550), 118 (5590), 126 (5630), 134 (5670) * [5725 - 5850 MHz]: 151 (5755), 159 (5795)                                                                                                                                                               |
|         |                   |            | [BW 80 MHz] x 5 non-overlapping channels, # (center freq. MHz): *<br>[5150 - 5250 MHz]: 42 (5210) * [5250 - 5350 MHz]: 58 (5290) *<br>[5470 - 5725 MHz]: 106 (5530), 122 (5610) * [5725 - 5850 MHz]: 155 (5775)                                                                                                                                                                                                                                     |

**Note** A table containing transmit power values will be added in a subsequent revision of this manual.

## FCC notices

**IMPORTANT:** The ConnectCore 8X module has been certified by the FCC for use with other products without any further certification (as per FCC section 2.1091). Modifications not expressly approved by Digi could void the user's authority to operate the equipment.

**IMPORTANT:** OEMs must test final product to comply with unintentional radiators (FCC section 15.107 & 15.109) before declaring compliance of their final product to Part 15 of the FCC Rules.

**IMPORTANT:** The ConnectCore 8X module has been certified for remote and base radio applications. If the module will be used for portable applications, the device must undergo SAR testing. This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates uses and can radiate radio frequency energy, and if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures: Re-orient or relocate the receiving antenna, Increase the separation between the equipment and receiver, Connect equipment and receiver to outlets on different circuits, or Consult the dealer or an experienced radio/TV technician for help.

**IMPORTANT: This module has been tested and found to comply with the following requirements for Modular Approval.**

**Part 15.247 - Operation within the bands 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz.**

**Part 15.407 – General technical requirements.**

## FCC-approved antennas

The ConnectCore 8X can be installed utilizing antennas and cables constructed with non-standard connectors (RPSMA, RPTNC, and so on).

The modules are FCC approved for fixed base station and mobile applications for the channels indicated in the tables below. If the antenna is mounted at least 20 cm (8 in) from nearby persons, the application is considered a mobile application. Antennas not listed in the table must be tested to comply with FCC Section 15.203 (Unique Antenna Connectors) and Section 15.247 (Emissions).

The following table shows the antenna that was used to certify the ConnectCore 8X wireless module. This antenna can be replaced by others, however further certification testing is required. The number of tests to be carried out can be decreased by using an antenna of the same type, i.e. dualband omnidirectional dipole, showing lower peak gain. In such case, only a spot check may be required by the certification laboratories to keep current certifications valid according to FCC regulations. If replacing by an antenna with higher gain, complete radiated tests according to FCC regulations are required by the certification laboratories.

### *Antenna used to certify the ConnectCore 8X wireless module*

| Antenna type | Supplier | Antenna part no.  | Freq. (MHz) | Peak antenna gain (dBi) | Directional gain (dBi) |
|--------------|----------|-------------------|-------------|-------------------------|------------------------|
| PCB          | YAGEO    | ANTX100P001B24553 | 2402~2480   | 4.6                     | 7.61                   |
|              |          |                   | 5150~5250   | 4.9                     | 7.91                   |
|              |          |                   | 5250~5350   | 3.9                     | 6.91                   |
|              |          |                   | 5470~5725   | 5.1                     | 8.11                   |
|              |          |                   | 5725~5850   | 5.1                     | 8.11                   |
| PCB          | TAOGLAS  | FXP830.07.0100C   | 2402~2480   | 3.32                    | 6.33                   |
|              |          |                   | 5150~5250   | 6.11                    | 9.12                   |
|              |          |                   | 5250~5350   | 6.11                    | 9.12                   |
|              |          |                   | 5470~5725   | 6.11                    | 9.12                   |
|              |          |                   | 5725~5850   | 6.11                    | 9.12                   |
| Dipole       | TAOGLAS  | GW.48.A151        | 2402~2480   | 3.42                    | 6.43                   |
|              |          |                   | 5150~5250   | 4.56                    | 7.57                   |
|              |          |                   | 5250~5350   | 4.56                    | 7.57                   |
|              |          |                   | 5470~5725   | 4.56                    | 7.57                   |
|              |          |                   | 5725~5850   | 4.56                    | 7.57                   |

| Antenna type | Supplier    | Antenna part no.  | Freq. (MHz) | Peak antenna gain (dBi)        | Directional gain (dBi) |
|--------------|-------------|-------------------|-------------|--------------------------------|------------------------|
| PCB          | TAOGLAS     | FXP522.A.07.A.001 | 2402~2480   | 3.78 (Port 1)<br>3.15 (Port 2) | 6.79                   |
|              |             |                   | 5150~5250   | 4.63 (Port 1)<br>4.61 (Port 2) | 7.64                   |
|              |             |                   | 5250~5350   | 4.63 (Port 1)<br>4.61 (Port 2) | 7.64                   |
|              |             |                   | 5470~5725   | 4.63 (Port 1)<br>4.61 (Port 2) | 7.64                   |
|              |             |                   | 5725~5850   | 4.63 (Port 1)<br>4.61 (Port 2) | 7.64                   |
| Dipole       | Linx        | ANT-DB1-RAF-RPS   | 2402~2480   | 2.5                            | 5.51                   |
|              |             |                   | 5150~5250   | 4.6                            | 7.61                   |
|              |             |                   | 5250~5350   | 4.6                            | 7.61                   |
|              |             |                   | 5470~5725   | 4.6                            | 7.61                   |
|              |             |                   | 5725~5850   | 4.6                            | 7.61                   |
| PCB          | Ethertronic | 1001932           | 2402~2480   | 2.5                            | 5.51                   |
|              |             |                   | 5150~5250   | 5                              | 8.01                   |
|              |             |                   | 5250~5350   | 5                              | 8.01                   |
|              |             |                   | 5470~5725   | 5                              | 8.01                   |
|              |             |                   | 5725~5850   | 5                              | 8.01                   |
| PCB          | TAOGLAS     | FXP831.07.0100C   | 2402~2480   | 3                              | 6.01                   |
|              |             |                   | 5150~5250   | 5.5                            | 8.51                   |
|              |             |                   | 5250~5350   | 5.5                            | 8.51                   |
|              |             |                   | 5470~5725   | 5.5                            | 8.51                   |
|              |             |                   | 5725~5850   | 5.5                            | 8.51                   |

**Note** If using the RF module in a portable application (for example - if the module is used in a hand-held device and the antenna is less than 20 cm (8 in) from the human body when the device is in operation): The integrator is responsible for passing additional SAR (Specific Absorption Rate) testing based on FCC rules 2.1091 and FCC Guidelines for Human Exposure to Radio Frequency Electromagnetic Fields, OET Bulletin and Supplement C. The testing results will be submitted to the FCC for approval prior to selling the integrated unit. The required SAR testing measures emissions from the module and how they affect the person.

## RF exposure

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**CAUTION!** To satisfy FCC RF exposure requirements for mobile transmitting devices, a separation distance of 20 cm (8 in) or more should be maintained between the antenna of this device and persons during device operation. To ensure compliance, operations at closer than this distance are not recommended. The antenna used for this transmitter must not be co-located in conjunction with any other antenna or transmitter. The preceding statement must be included as a CAUTION statement in OEM product manuals in order to alert users of FCC RF Exposure compliance.

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## Operating frequency

- 802.11 b/g/n: 2412-2462 MHz
- 802.11 a/n/ac : 5150-5250 MHz; 5250-5350 MHz; 5470-5725MHz; 5725-5850 MHz
- Bluetooth : 2402-2480 MHz

## Europe

- 2.412 to 2.472 GHz; 13 channels
- 5.180 to 5.320 GHz; 8 channels
- 5.500 to 5.700 GHz, 8 channels (excludes 5.600 to 5.640 GHz)

## CE mark

The ConnectCore 8X module is certified for use in several European countries. For information, visit [www.digi.com/resources/certifications](http://www.digi.com/resources/certifications).

If the ConnectCore 8X module is incorporated into a product, the manufacturer must ensure compliance of the final product with articles 3.1a and 3.1b of the RE Directive (Radio Equipment Directive). A Declaration of Conformity must be issued for each of these standards and kept on file as described in the RE Directive (Radio Equipment Directive).

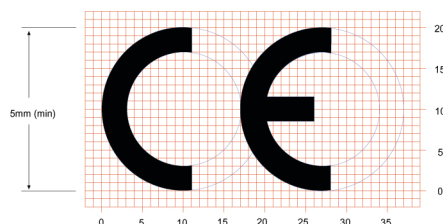
Furthermore, the manufacturer must maintain a copy of the ConnectCore 8X module user manual documentation and ensure the final product does not exceed the specified power ratings, antenna specifications, and/or installation requirements as specified in the user manual. If any of these specifications are exceeded in the final product, a submission must be made to a notified body for compliance testing to all required standards.

**This equipment should be installed and operated with a minimum distance of 20 cm between the radiator and your body.**

## OEM labeling requirements

The **CE** marking must be affixed to a visible location on the OEM product.

## CE labeling requirements



The CE mark shall consist of the initials **CE** taking the following form:

- If the CE marking is reduced or enlarged, the proportions given in the above graduated drawing must be respected.
- The CE marking must have a height of at least 5mm except where this is not possible on account of the nature of the apparatus.
- The CE marking must be affixed visibly, legibly, and indelibly.

## Declarations of Conformity

Digi has issued Declarations of Conformity for the ConnectCore 8X system-on-module concerning emissions, EMC, and safety. For more information, see <http://www.digi.com/resources/certifications>.

### Important note

Digi customers assume full responsibility for learning and meeting the required guidelines for each country in their distribution market. Refer to the radio regulatory agency in the desired countries of operation for more information.

## Approved antennas

The same antennas have been approved for Europe as stated in the FCC table for use with the ConnectCore 8X module.

### Country list

|    |    |    |    |    |
|----|----|----|----|----|
|    |    |    |    |    |
| AT | BE | BG | CZ | DK |
| EE | FR | DE | IS | IE |
| IT | EL | ES | CY | LV |
| LI | LT | LU | HU | MT |
| NL | NO | PL | PT | RO |
| SI | SK | TR | FI | SE |
| CH | UK | HR |    |    |

**Note** This device is restricted to indoor use only when operating in the 5150-5350MHz frequency range within all member states.

## Canada (IC)

**IC:** 1846A-CCIMX8

**PMN:** CC8X

**HVIN:** ConnectCore 8X

### Canadian Notice

This device contains licence-exempt transmitter(s)/receiver(s) that comply with Innovation, Science and Economic Development Canada's licence-exempt RSS(s). Operation is subject to the following two conditions:

1. This device may not cause interference.
2. This device must accept any interference, including interference that may cause undesired operation of the device.

Avis Canadien

L'émetteur/récepteur exempt de licence contenu dans le présent appareil est conforme aux CNR d'Innovation, Sciences et Développement économique Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes :

1. L'appareil ne doit pas produire de brouillage;
2. L'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

### Labeling requirements

Labeling requirements for Industry Canada are similar to those of the FCC.

#### **Required End Product Labeling**

Any device incorporating this module must include an external, visible, permanent marking or label which states: "Contains IC : 1846A-CCIMX8"

Obligation d'étiquetage du produit final:

Tout dispositif intégrant ce module doit comporter un externe, visible, marquage permanent ou une étiquette qui dit: "Contient IC : 1846A-CCIMX8"

### Transmitters with detachable antennas

This radio transmitter (IC: 1846A-CCIMX8) has been approved by Industry Canada to operate with the antenna types listed in the table above with the maximum permissible gain and required antenna impedance for each antenna type indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

Le présent émetteur radio (IC: 1846A-CCIMX8) a été approuvé par Industrie Canada pour fonctionner avec les types d'antenne énumérés ci-dessous et ayant un gain admissible maximal et l'impédance requise pour chaque type d'antenne. Les types

d'antenne non inclus dans cette liste, ou dont le gain est supérieur au gain maximal indiqué, sont strictement interdits pour l'exploitation de l'émetteur.

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the

equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication.

Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotrope rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante.

The ConnectCore 8X module is for professional (OEM) installation only.

Le module ConnectCore 8X doit impérativement être installé par un professionnel (OEM).

## RF exposure



To satisfy Industry Canada RF exposure requirements, a separation distance of 20 cm or more should be maintained between the antenna of this device and persons during device operation.

Pour satisfaire aux exigences d'Industrie Canada concernant l'exposition RF, une distance égale ou supérieure à 20cm doit être respectée entre les antennes de ce produit et les personnes se trouvant à proximité.

**The preceding statement must be included as a CAUTION statement in OEM product manuals in order to alert users of Industry Canada RF Exposure compliance.**

**Cette information doit être incluse dans le manuel du produit OEM afin d'alerter les utilisateurs sur la nécessité de respecter l'exposition RF d'Industrie Canada.**

## Approved antennas

The same antennas have been approved for Canada as stated in the FCC table for use with the ConnectCore 8X module.

## Japan

電波法により5GHz帯は屋内使用に限ります。

This device has been granted a designation number by Ministry of Internal Affairs and Communications according to:

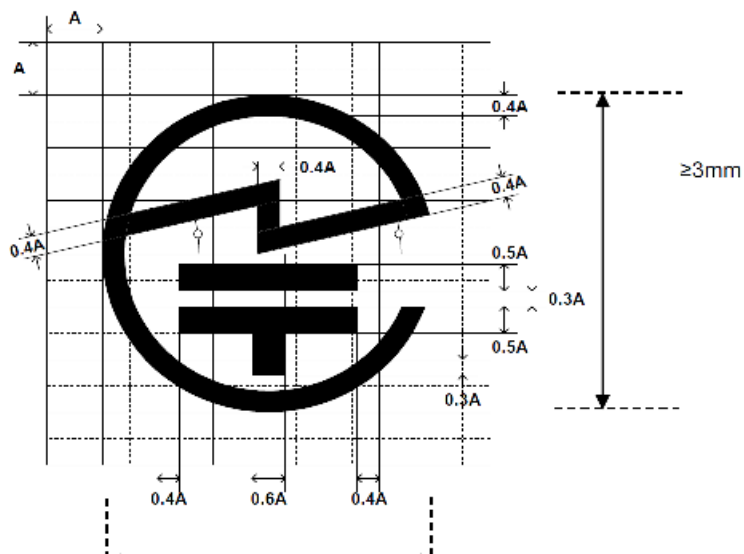
Ordinance concerning Technical Regulations Conformity Certification etc. of Specified Radio Equipment (特定無線設備の技術基準適合証明等に関する規則).

- Article 2, Paragraph 1, Item 19, 19-3, 19-3-2 Category: WW, XW, YW
- Model/Name of equipment: ConnectCore 8X
- Radio label marking:
  - R: 202-LSF056
  - T: D 17-0014 202

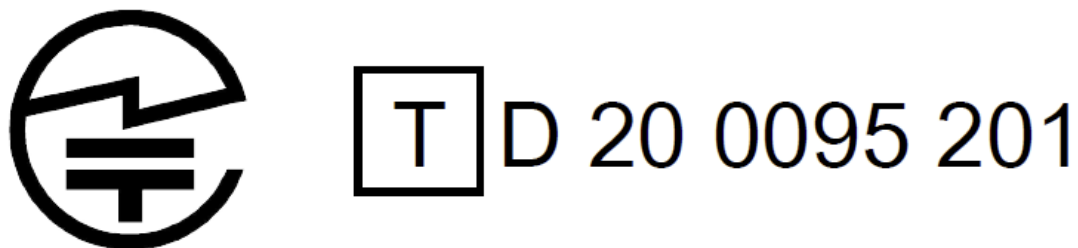
This device should not be modified (otherwise the granted designation number will be invalid).

- 2.412 to 2.472 GHz; 13 channels
- 5.180 to 5.320 GHz; 8 channels
- 5.500 to 5.700 GHz; 11 channels

### Approval Label (MIC Marking)



***Label text***



**Note** Due to space constraints, the ConnectCore 8X module label doesn't support radio marking for Japan. If space allows, end product label should support radio marking for Japan. If not, radio marking shall be documented in the user manual.

**Note** The warning “Indoor only(5GHz)” must go on the end product – or E Label (Display).