ConnectCore 8X

System-on-module

Hardware Reference Manual

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 nformation, and some graphics; updated MCA to trademarked name.
5P	May 2020	Added operating temperature statement.
A	August 2020	Added Canada, Europe, and Japan certifications; FCC notices; RF table; and antenna port section.

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About the ConnectCore® 8X

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 EX 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).

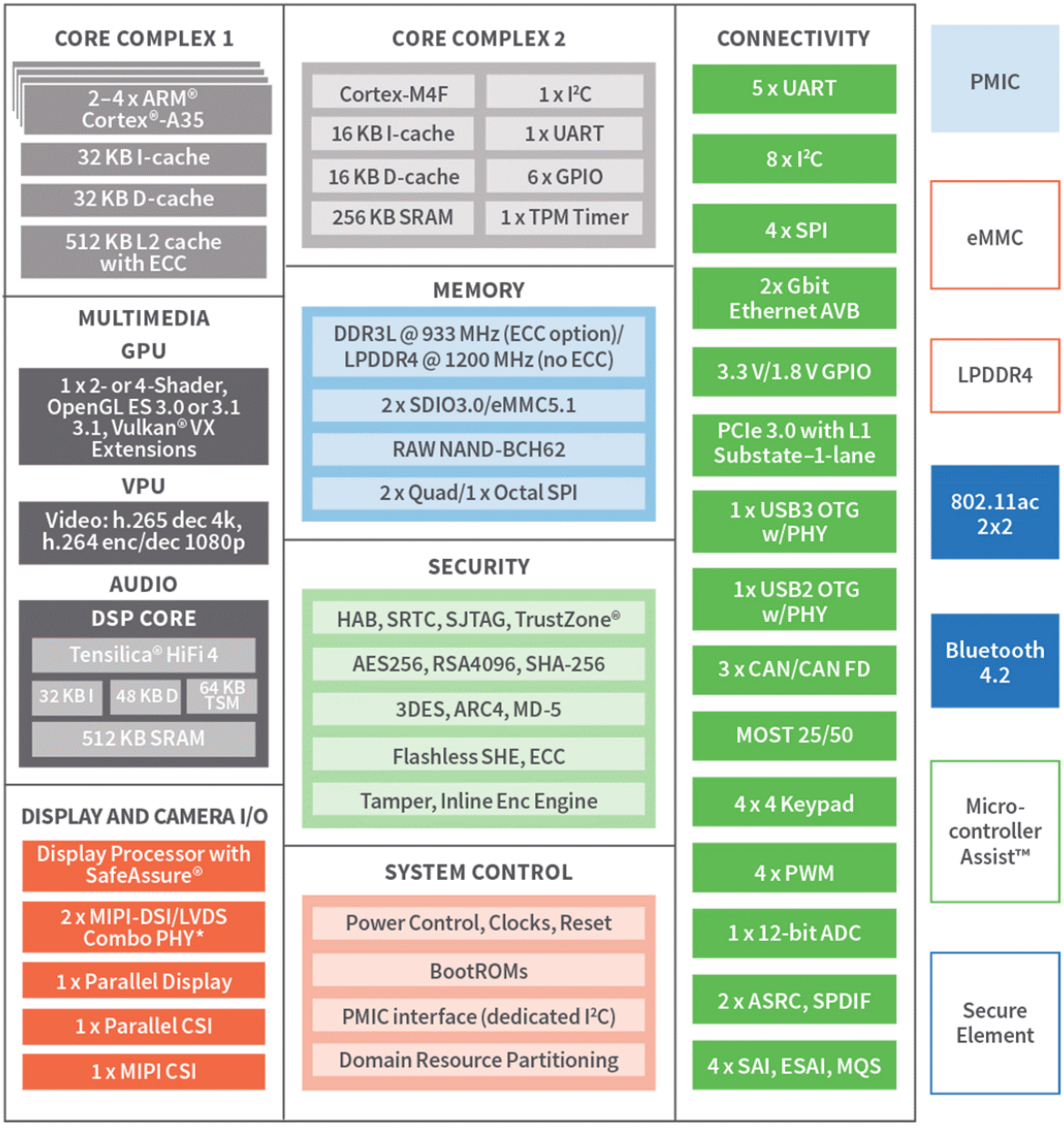
Module variants

See the full list of variants in the ConnectCore 8X documentation portal.

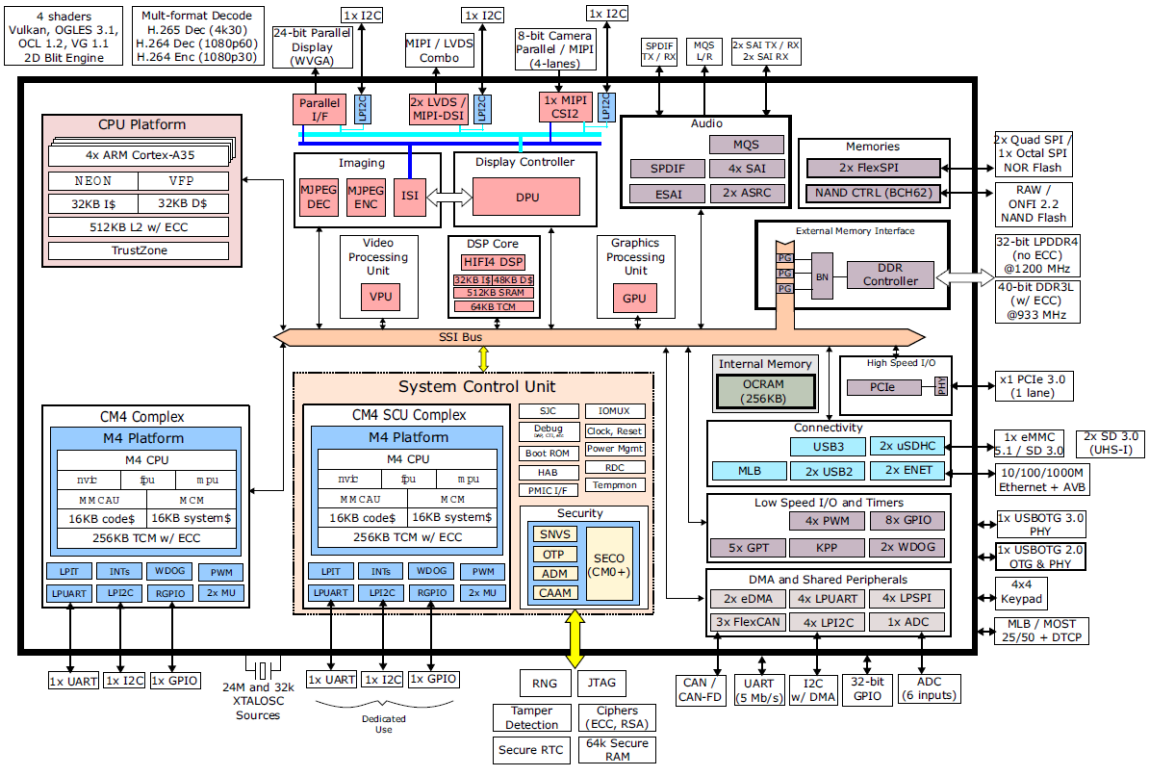
Block diagrams

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.

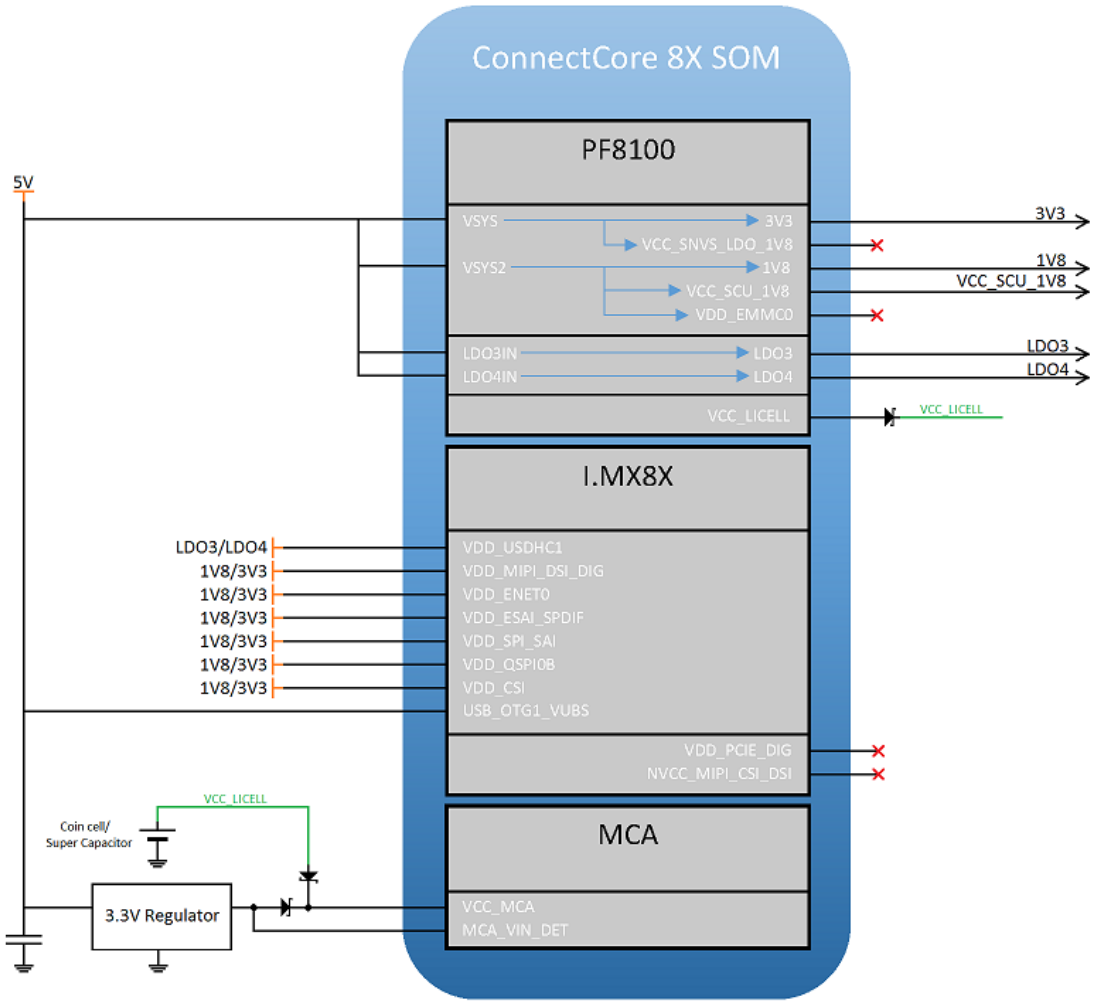
The ConnectCore 8X System-on-module

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	**YES**	**NO**	
SW2	-	VSYS2	**YES**	**NO**	
SW3	-	VSYS2	**YES**	**NO**	
SW4	-	VSYS2	**YES**	**NO**	
SW5	-	VSYS2	**YES**	**NO**	
SW6	1V8	VSYS2	**YES**	**YES**	General purpose 1.8V power rail for external circuitry. Also used internally in the SOM.
SW7	3V3	VSYS	**YES**	**YES**	General purpose 3.3V power rail for external circuitry. Also used internally in the SOM.
LDO1	VCC_SCU_1V8	VSYS2	**YES**	**YES**	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	**YES**	**YES**	Used for powering the internal eMMC0 memory. Digi recommends not using this power rail externally unless otherwise noted.
LDO3	LDO3	LDO3IN	**NO**	**YES**	
LDO4	LDO4	LDO4IN	**NO**	**YES**	

PMIC regulator	SoM power rail name	Input power supply	Internally used	Externally available	Comments
VSNVS	VCC_SNVS_LDO_1V8	VSYS / VCC_LICELL	**YES**	**YES**	An always-on power domain of the CPU that powers some core functionality of the SOM. Do not use this power rail externally.

Note 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 RTC power and coin cell charger.

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	■ VDD_ENET0_VSELECT_1P8_2P5_3P3 ■ VDD_ENET0_1P8_2P5_3P3 ■ VDD_ENET_MDIO_1P8_3P3	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	■ VDD_TMPR_CSI_1P8_3P3 ■ VDD_CSI_1P8_3P3	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 (2.7)	-	5.5
	VSYS2	TBD (3.0)	-	5.5

Device	SOM power rail		Input voltage (V)		
			Minimum	Typical	Maximum
	LDO3IN		2.5[1]	-	5.5
	LDO4IN		2.5[1]	-	5.5
MCA	**VCC_MCA**		2.4	-	3.6
CPU	**VDD_USDHC1** **VDD_MIPI_DSI_DIG** **VDD_ENET0** **VDD_SPI_SAI** **VDD_QSPI0B** **VDD_CSI**	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
	VDD_ESAI_SPDIF	2.5 V mode	2.40	2.50	2.60
		3.3 V mode	3.00	3.30	3.60
	USB_OTG1_VBUS		4.4	-	5.5

[1]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)[1]	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.

[1] 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.

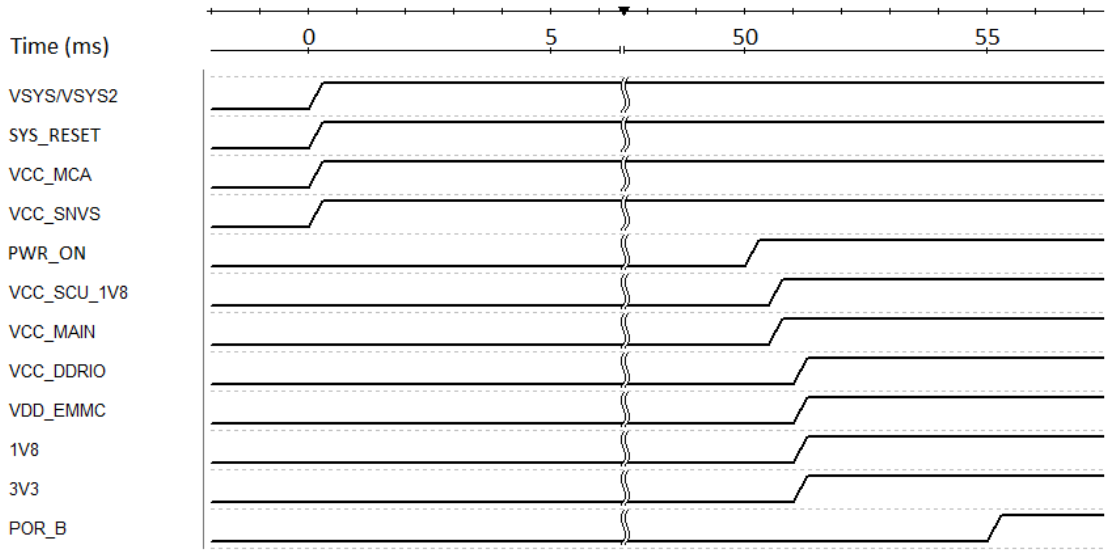
[2] Turn-on time for this regulator is specified for VSW7 = 1.8 V. In the ConnectCore 8X this regulator is configured to work at 3.3V, so a higher turn-on time may be observed.

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.

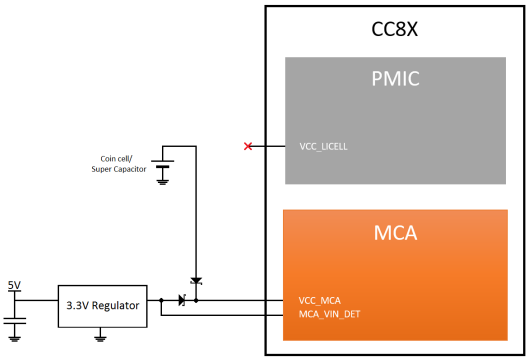


RTC power and coin cell charger

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.

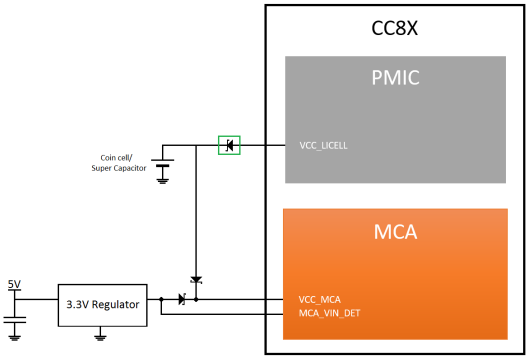
If the coin-cell charger functionality is mandatory, place a reverse diode between VCC_LICELL and the coin cell.

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 ouptut 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:

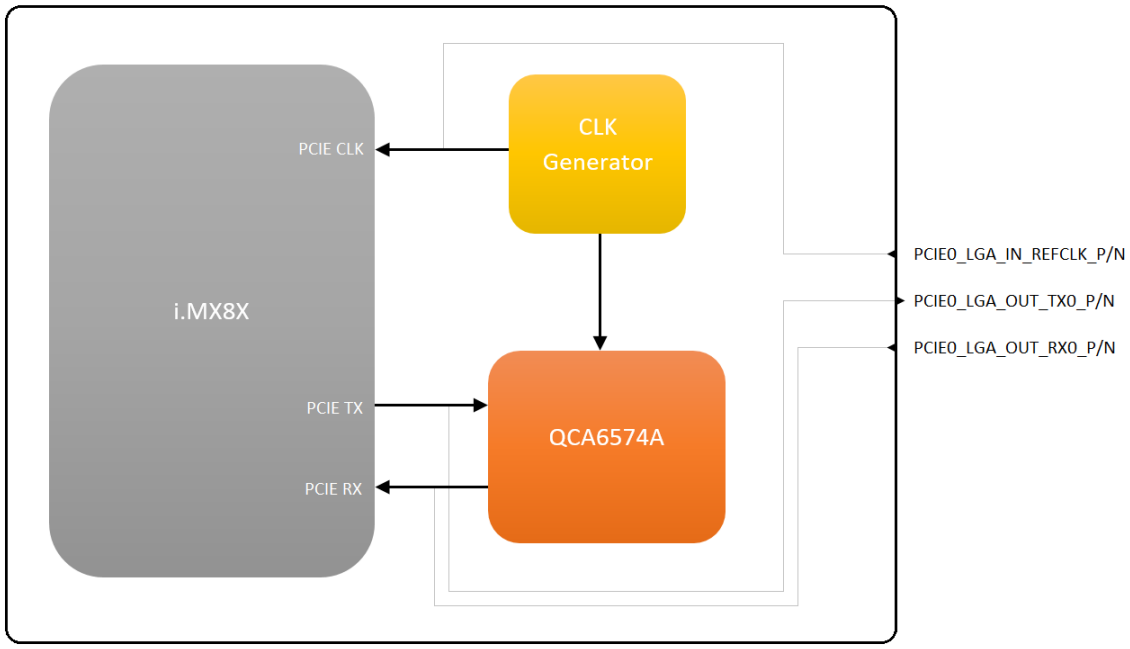
- Bluetooth 5.0; backwards compatible with Bluetooth 1.X, 2.X + Enhanced Data Rate, Bluetooth 3.X, Bluetooth 4.X, and Bluetooth class 1 and class 2 power-level transmissions
- Integrated WLAN-Bluetooth coexistence

See Bluetooth certification for more information.

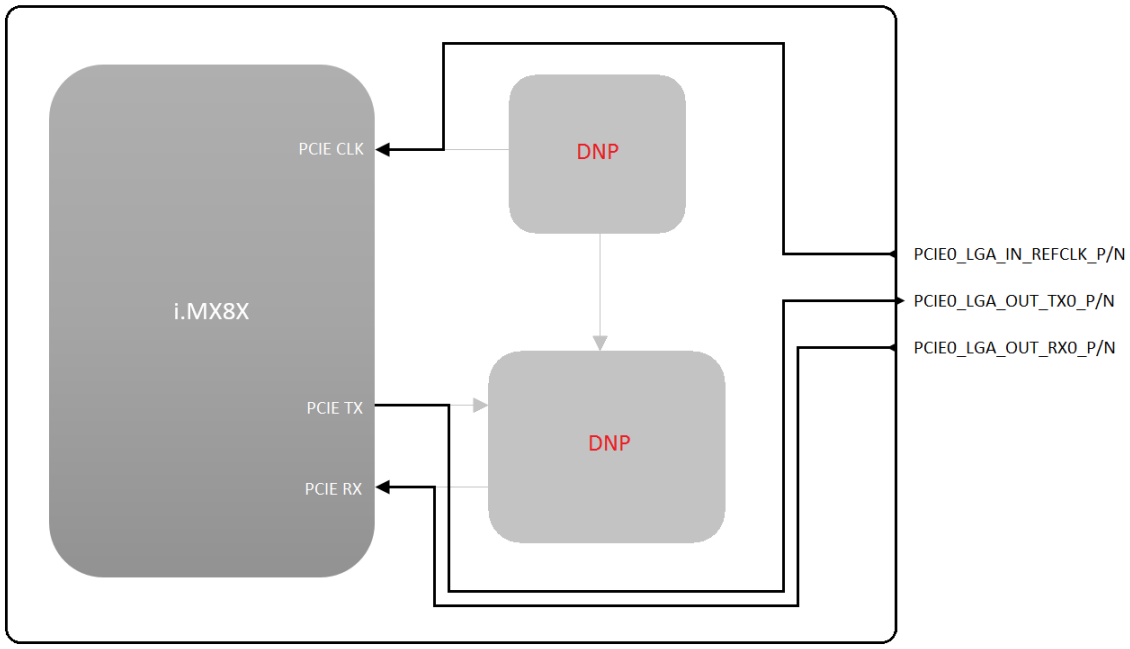
PCI Express

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).

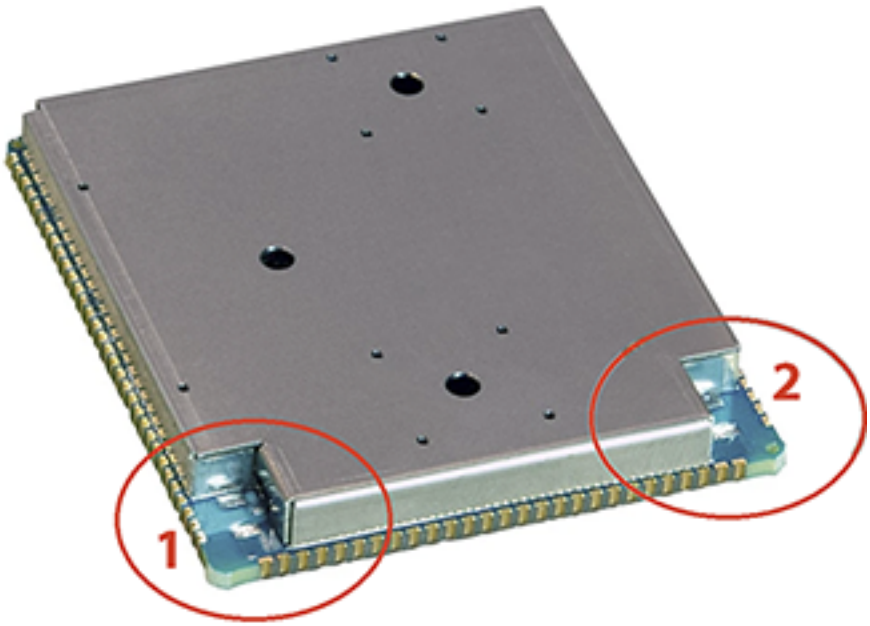
The following control lines can also be used externally in non-wireless variants:

- PCIE_LGA_OUT_CTRL0_WAKE_B
- PCIE_LGA_OUT_CTRL0_CLKREQ_B
- PCIE_LGA_OUT_CTRL0_PERST_B

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

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.

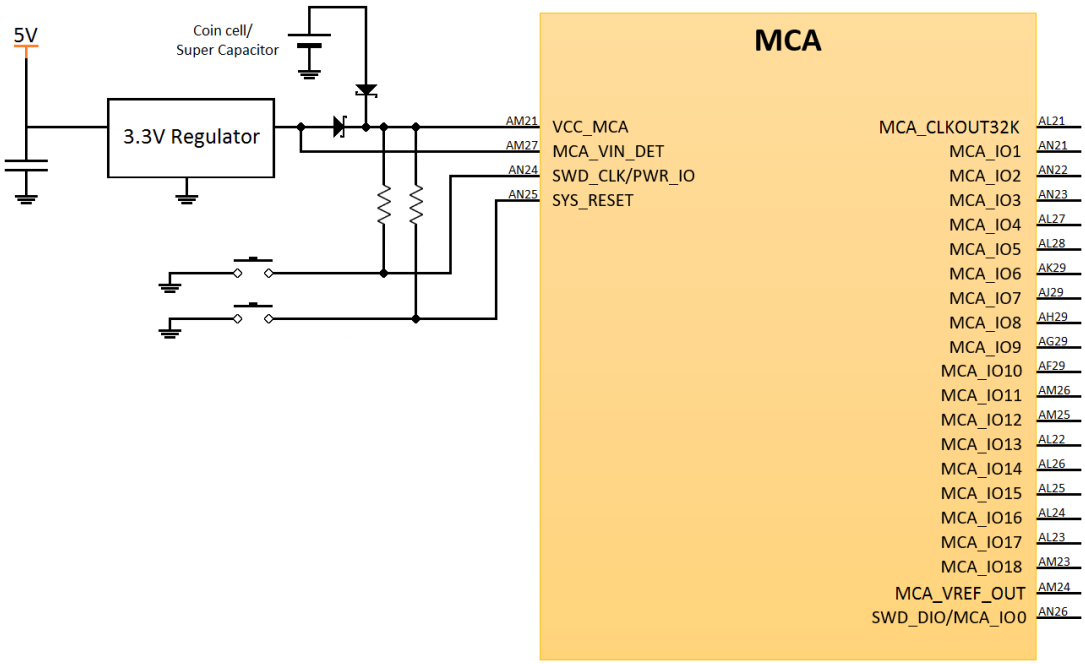
See the software documentation for information about supported cryptoauthentication features.

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:

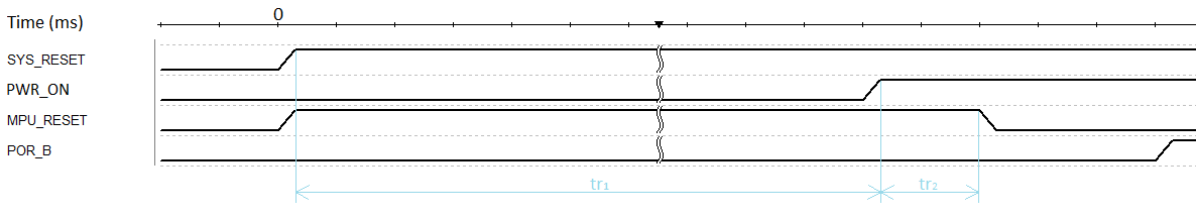
- Asserts the PMIC on/off line (SCU_PMIC_ON_REQ) low for a configurable time (0-255 ms with a default value of 50ms). This powers the PMIC off, switching off all regulated outputs of the PMIC. You can disable this power cycle by setting the timer to 0.
- Asserts the PMIC on/off line high to power the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

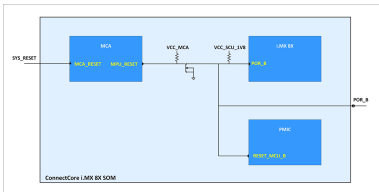
The following time diagram represents the reset sequence. Default values are as follows:

- 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.

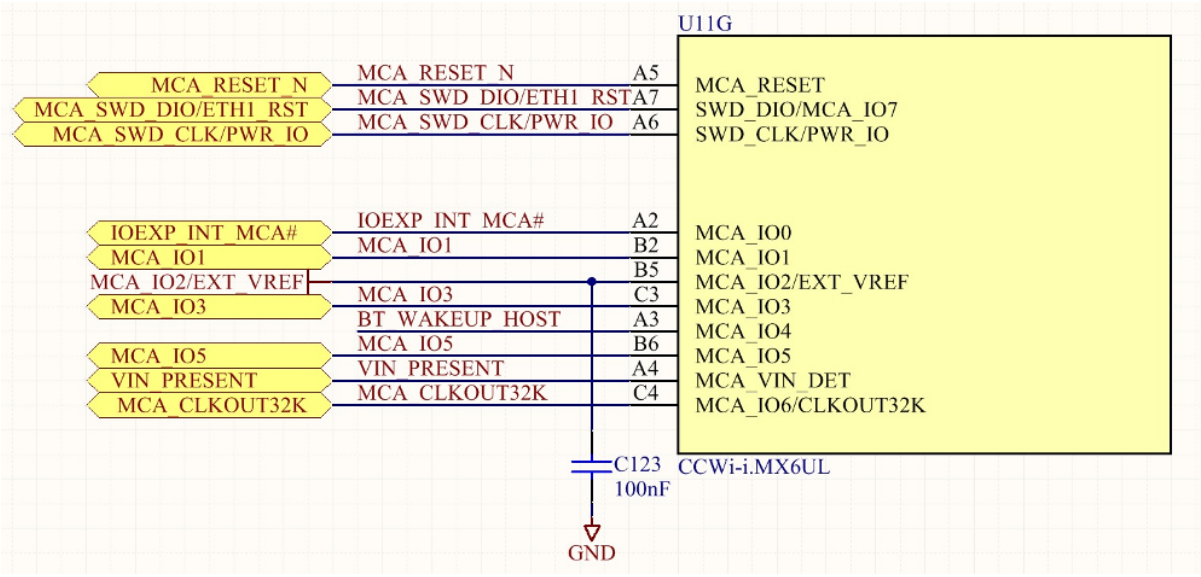
See the MCA software documentation for additional information about how to configure and access the MCA IRQ lines.

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:

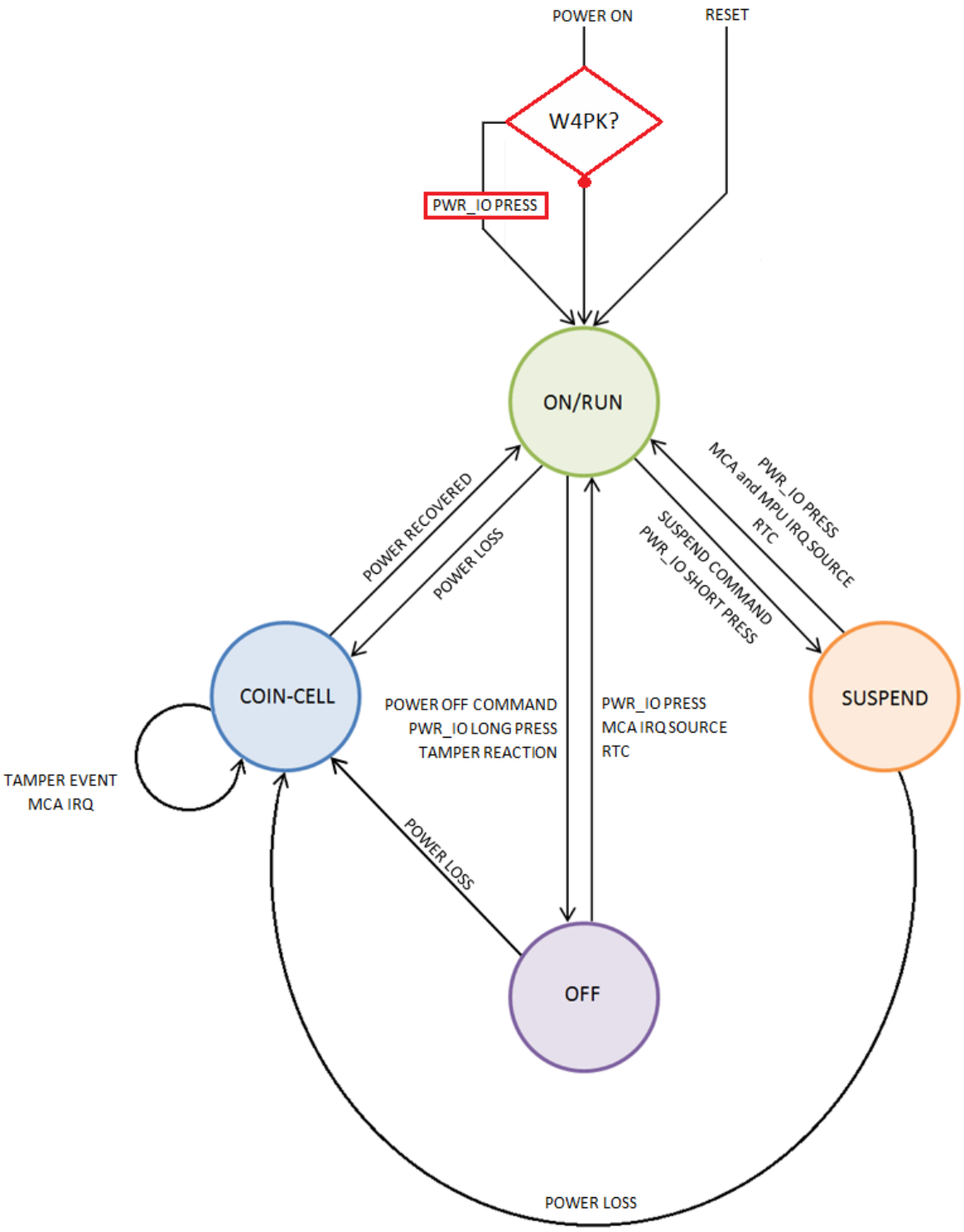
- All MCA PWM channels are available on the LGA pads.
- PWM0 channel 0 is available on the castellated pads.
- PWM1 channels 0 and 1 are available on the castellated pads.
- PWM2 channels 0 and 1 are available on the castellated pads.

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.

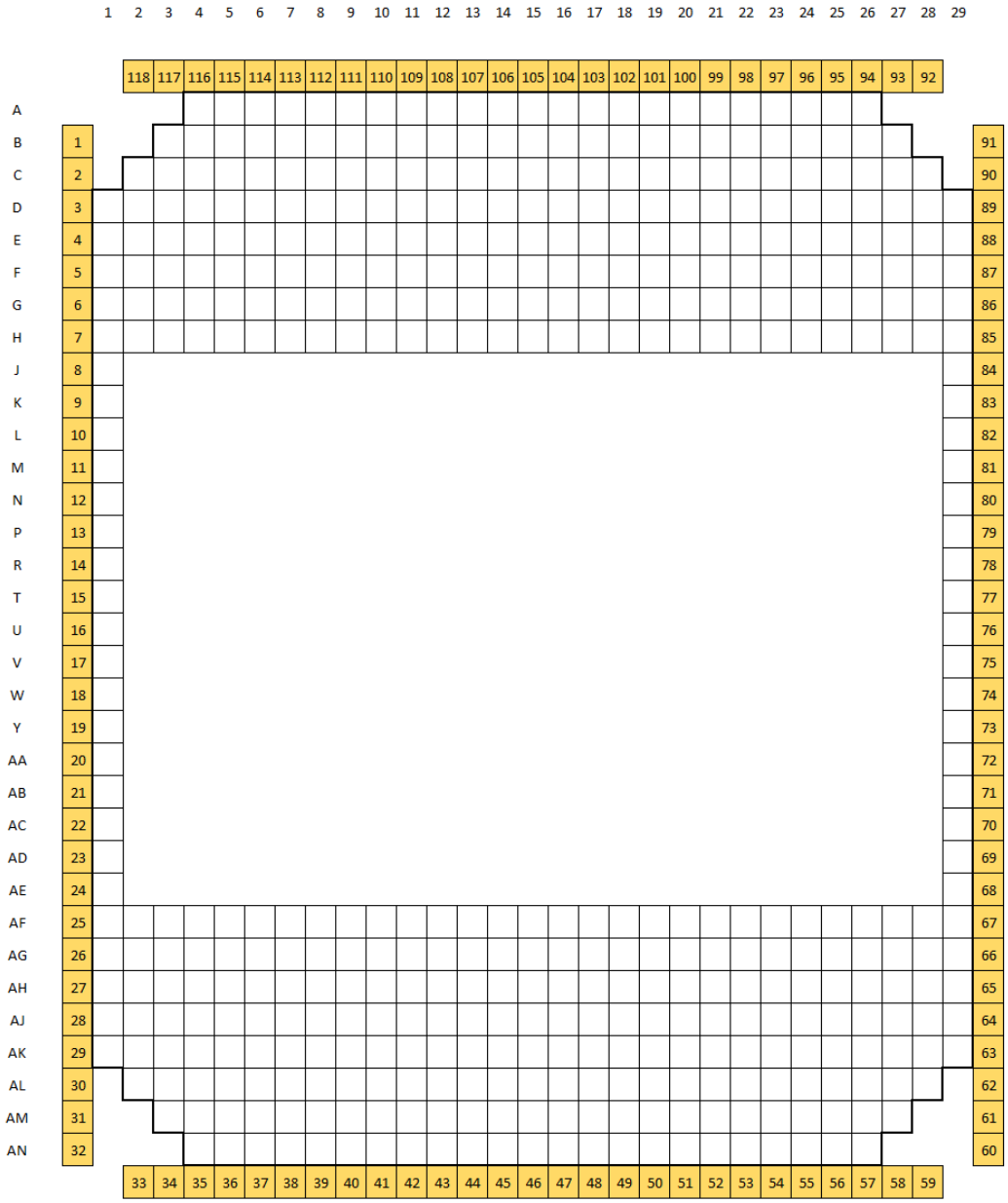
IOMUX

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.

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 **ALT1:** NAND_RE_N **ALT2:** SPI2_SCK **ALT3:** **ALT4:** GPIO4_IO19	VDD_USDHC1	
2	E3	USDHC1_VSELECT	USDHC1_VSELECT	**ALT0:** USDHC1_VSELECT **ALT1:** NAND_RE_P **ALT2:** SPI2_SDO **ALT3:** NAND_RE_B **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	**ALT0:** USDHC1_WP **ALT1:** NAND_DQS_N **ALT2:** SPI2_SDI **ALT3:** **ALT4:** GPIO4_IO21	VDD_USDHC1	
4	G2	USDHC1_CD_B	USDHC1_CD_B	**ALT0:** USDHC1_CD_B **ALT1:** NAND_DQS_P **ALT2:** SPI2_CS0 **ALT3:** NAND_DQS **ALT4:** GPIO4_IO22	VDD_USDHC1	
5	F1	USDHC1_CMD	USDHC1_CMD	**ALT0:** USDHC1_CMD **ALT1:** NAND_CE0_B **ALT2:** MQS_R **ALT3:** **ALT4:** GPIO4_IO24	VDD_USDHC1	
6	G1	USDHC1_DATA0	USDHC1_DATA0	**ALT0:** USDHC1_DATA0 **ALT1:** NAND_CE1_B **ALT2:** MQS_L **ALT3:** **ALT4:** GPIO4_IO25	VDD_USDHC1	
7	H1	USDHC1_DATA1	USDHC1_DATA1	**ALT0:** USDHC1_DATA1 **ALT1:** NAND_RE_B **ALT2:** UART3_TX **ALT3:** **ALT4:** GPIO4_IO26	VDD_USDHC1	
8	J1	USDHC1_DATA2	USDHC1_DATA2	**ALT0:** USDHC1_DATA2 **ALT1:** NAND_WE_B **ALT2:** UART3_CTS_B **ALT3:** **ALT4:** 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	**ALT0:** USDHC1_DATA3 **ALT1:** NAND_ALE **ALT2:** UART3_RTS_B **ALT3:** **ALT4:** GPIO4_IO28	VDD_USDHC1	
10	L1	USDHC1_CLK	USDHC1_CLK	**ALT0:** USDHC1_CLK **ALT1:** **ALT2:** UART3_RX **ALT3:** **ALT4:** GPIO4_IO23	VDD_USDHC1	
11	M1	GND	-	-	-	
12	N1	VDD_USDHC1	-	-	VDD_USDHC1	
13	P1	UART0_TX	UART0_TX	**ALT0:** UART0_TX **ALT1:** MQS_L **ALT2:** FLEXCAN0_TX **ALT3:** **ALT4:** GPIO1_IO22	3V3	
14	R1	UART0_RX	UART0_RX	**ALT0:** UART0_RX **ALT1:** MQS_R **ALT2:** FLEXCAN0_RX **ALT3:** **ALT4:** 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	**ALT0:** MIPI_DSI0_I2C0_SCL **ALT1:** MIPI_DSI1_GPIO0_IO02 **ALT2:** **ALT3:** **ALT4:** GPIO1_IO25	VDD_MIPI_DSI_DIG	
18	W1	MIPI_DSI0_I2C0_SDA	MIPI_DSI0_I2C0_SDA	**ALT0:** MIPI_DSI0_I2C0_SDA **ALT1:** MIPI_DSI1_GPIO0_IO03 **ALT2:** **ALT3:** **ALT4:** GPIO1_IO26	VDD_MIPI_DSI_DIG	
19	Y1	MIPI_DSI0_GPIO0_00	MIPI_DSI0_GPIO0_00	**ALT0:** MIPI_DSI0_GPIO0_IO00 **ALT1:** I2C1_SCL **ALT2:** MIPI_DSI0_PWM0_OUT **ALT3:** **ALT4:** GPIO1_IO27	VDD_MIPI_DSI_DIG	
20	AA1	MIPI_DSI0_GPIO0_01	MIPI_DSI0_GPIO0_01	**ALT0:** MIPI_DSI0_GPIO0_IO01 **ALT1:** I2C1_SDA **ALT2:** **ALT3:** **ALT4:** GPIO1_IO28	VDD_MIPI_DSI_DIG	
21	AB1	MIPI_DSI1_I2C0_SCL	MIPI_DSI1_I2C0_SCL	**ALT0:** MIPI_DSI1_I2C0_SCL **ALT1:** MIPI_DSI0_GPIO0_IO02 **ALT2:** **ALT3:** **ALT4:** GPIO1_IO29	VDD_MIPI_DSI_DIG	
22	AC1	MIPI_DSI1_I2C0_SDA	MIPI_DSI1_I2C0_SDA	**ALT0:** MIPI_DSI1_I2C0_SDA **ALT1:** MIPI_DSI0_GPIO0_IO03 **ALT2:** **ALT3:** **ALT4:** 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	**ALT0:** MIPI_DSI1_GPIO0_IO00 **ALT1:** I2C2_SCL **ALT2:** MIPI_DSI1_PWM0_OUT **ALT3:** **ALT4:** GPIO1_IO31	VDD_MIPI_DSI_DIG	
24	AE1	MIPI_DSI1_GPIO0_01	MIPI_DSI1_GPIO0_01	**ALT0:** MIPI_DSI1_GPIO0_IO01 **ALT1:** I2C2_SDA **ALT2:** **ALT3:** **ALT4:** GPIO2_IO00	VDD_MIPI_DSI_DIG	
25	AF1	QSPI0A_SS1_B	QSPI0A_SS1_B	**ALT0:** QSPI0A_SS1_B **ALT1:** **ALT2:** **ALT3:** **ALT4:** GPIO3_IO15	3V3	
26	AG1	QSPI0A_SCLK	QSPI0A_SCLK	**ALT0:** QSPI0A_SCLK **ALT1:** **ALT2:** **ALT3:** **ALT4:** 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	**ALT0:** QSPI0A_DQS **ALT1:** **ALT2:** **ALT3:** **ALT4:** GPIO3_IO13	3V3	
36	AN5	QSPI0A_SS0_B	QSPI0A_SS0_B	**ALT0:** QSPI0A_SS0_B **ALT1:** **ALT2:** **ALT3:** **ALT4:** 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	-	**ALT0:** ADC0_DP1/ADC0_SE1 **ALT1:** PTE16 **ALT2:** SPI0_PCS0 **ALT3:** UART2_TX **ALT4:** TPM_CLKIN0 **ALT5:** **ALT6:** FXIO0_D0 **ALT7:**	VCC_MCA	
53	AN22	MCA_IO2	-	**ALT0:** ADC0_DM1/ADC0_SE5a **ALT1:** PTE17 **ALT2:** SPI0_SCK **ALT3:** UART2_RX **ALT4:** TPM_CLKIN1 **ALT5:** LPTMR0_ALT3 **ALT6:** FXIO0_D1 **ALT7:**	VCC_MCA	
54	AN23	MCA_IO3	-	**ALT0:** ADC0_DP2/ADC0_SE2 **ALT1:** PTE18 **ALT2:** SPI0_MOSI **ALT3:** **ALT4:** I2C0_SDA **ALT5:** SPI0_MISO **ALT6:** FXIO0_D2 **ALT7:**	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	-	**ALT0:** **ALT1:** PTA0 **ALT2:** **ALT3:** TPM0_CH5 **ALT4:** **ALT5:** **ALT6:** **ALT7:** 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	-	**ALT0:** **ALT1:** PTA3 **ALT2:** I2C1_SCL **ALT3:** TPM0_CH0 **ALT4:** **ALT5:** **ALT6:** **ALT7:** 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	-	**ALT0:** ADC0_DM2/ADC0_SE6a **ALT1:** PTE19 **ALT2:** SPI0_MISO **ALT3:** **ALT4:** I2C0_SCL **ALT5:** SPI0_MOSI **ALT6:** FXIO0_D3 **ALT7:**	VCC_MCA	
62	AL28	MCA_IO5	-	**ALT0:** ADC0_DP0/ADC0_SE0 **ALT1:** PTE20 **ALT2:** **ALT3:** TPM1_CH0 **ALT4:** LPUART0_TX **ALT5:** **ALT6:** FXIO0_D4 **ALT7:**	VCC_MCA	
63	AK29	MCA_IO6	-	**ALT0:** ADC0_DM0/ADC0_SE4a **ALT1:** PTE21 **ALT2:** **ALT3:** PTM1_CH1 **ALT4:** LPUART0_RX **ALT5:** **ALT6:** FXIO0_D5 **ALT7:**	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	-	**ALT0:** ADC0_DP3/ADC0_SE3 **ALT1:** PTE22 **ALT2:** **ALT3:** TPM2_CH0 **ALT4:** UART2_TX **ALT5:** **ALT6:** FXIO0_D6 **ALT7:**	VCC_MCA	
65	AH29	MCA_IO8	-	**ALT0:** ADC0_DM3/ADC0_SE7a **ALT1:** PTE23 **ALT2:** **ALT3:** TPM2_CH1 **ALT4:** UART2_RX **ALT5:** **ALT6:** FXIO0_D7 **ALT7:**	VCC_MCA	
66	AG29	MCA_IO9	-	**ALT0:** **ALT1:** PTA1 **ALT2:** LPUART0_RX **ALT3:** TPM2_CH0 **ALT4:** **ALT5:** **ALT6:** **ALT7:**	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	-	**ALT0:** **ALT1:** PTA2 **ALT2:** LPUART0_TX **ALT3:** TPM2_CH1 **ALT4:** **ALT5:** **ALT6:** **ALT7:**	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	**ALT0:** SCU_GPIO0_IO00 **ALT1:** SCU_UART0_RX **ALT2:** M40_UART0_RX **ALT3:** UART3_RX **ALT4:** GPIO2_IO03	VCC_SCU_1V8	
71	AB29	SCU_GPIO0_01	SCU_GPIO0_01	**ALT0:** SCU_GPIO0_IO01 **ALT1:** SCU_UART0_TX **ALT2:** M40_UART0_TX **ALT3:** UART3_TX **ALT4:** 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	**ALT0:** UART2_TX **ALT1:** FTM_CH1 **ALT2:** FLEXCAN1_TX **ALT3:** **ALT4:** GPIO1_IO23	3V3	
75	V29	UART2_RX	UART2_RX	**ALT0:** UART2_RX **ALT1:** FTM_CH0 **ALT2:** FLEXCAN1_RX **ALT3:** **ALT4:** GPIO1_IO24	3V3	
76	U29	FLEXCAN2_RX	FLEXCAN2_RX	**ALT0:** FLEXCAN2_RX **ALT1:** SAI3_RXD **ALT2:** UART3_RX **ALT3:** SAI1_RXFS **ALT4:** GPIO1_IO19	3V3	
77	T29	FLEXCAN2_TX	FLEXCAN2_TX	**ALT0:** FLEXCAN2_TX **ALT1:** SAI3_RXFS **ALT2:** UART3_TX **ALT3:** SAI1_RXC **ALT4:** GPIO1_IO20	3V3	
78	R29	FLEXCAN1_RX	FLEXCAN1_RX	**ALT0:** FLEXCAN1_RX **ALT1:** SAI2_RXFS **ALT2:** FTM_CH2 **ALT3:** SAI1_TXD **ALT4:** GPIO1_IO17	3V3	
79	P29	FLEXCAN1_TX	FLEXCAN1_TX	**ALT0:** FLEXCAN1_TX **ALT1:** SAI3_RXC **ALT2:** DMA0_REQ_IN0 **ALT3:** SAI1_RXD **ALT4:** 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	**ALT0:** FLEXCAN0_RX **ALT1:** SAI2_RXC **ALT2:** UART0_RTS_B **ALT3:** SAI1_TXC **ALT4:** GPIO1_IO15	3V3	
81	M29	FLEXCAN0_TX	FLEXCAN0_TX	**ALT0:** FLEXCAN0_TX **ALT1:** SAI2_RXD **ALT2:** UART0_CTS_B **ALT3:** SAI1_TXFS **ALT4:** GPIO1_IO16	3V3	
82	L29	ADC_IN1	ADC_IN1	**ALT0:** ADC_IN1 **ALT1:** M40_I2C0_SDA **ALT2:** M40_GPIO0_IO01 **ALT3:** **ALT4:** GPIO1_IO09	1V8	
83	K29	ADC_IN0	ADC_IN0	**ALT0:** ADC_IN0 **ALT1:** M40_I2C0_SCL **ALT2:** M40_GPIO0_IO00 **ALT3:** **ALT4:** GPIO1_IO10	1V8	
84	J29	ADC_VREFH	-	-	-	
85	H29	GND	-	-	-	
86	G29	MCLK_OUT0	MCLK_OUT0	**ALT0:** MCLK_OUT0 **ALT1:** ESAI0_TX_HF_CLK **ALT2:** LCDIF_CLK **ALT3:** SPI2_SDO **ALT4:** 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	**ALT0:** MCLK_IN0 **ALT1:** ESAI0_RX_HF_CLK **ALT2:** LCDIF_VSYNC **ALT3:** SPI2_SDI **ALT4:** GPIO0_IO19	3V3	
88	E29	MCLK_IN1	MCLK_IN1	**ALT0:** MCLK_IN1 **ALT1:** I2C3_SDA **ALT2:** LCDIF_EN **ALT3:** SPI2_SCK **ALT4:** LCDIF_D17	3V3	
89	F28	SPI3_CS1	SPI3_CS1	**ALT0:** SPI3_CS1 **ALT1:** I2C3_SCL **ALT2:** LCDIF_RESET **ALT3:** SPI2_CS0 **ALT4:** LCDIF_D16	3V3	
90	E28	SPI3_SCK	SPI3_SCK	**ALT0:** SPI3_SCK **ALT1:** **ALT2:** LCDIF_D13 **ALT3:** **ALT4:** GPIO0_IO13	3V3	
91	E27	SPI3_SDO	SPI3_SDO	**ALT0:** SPI3_SDO **ALT1:** **ALT2:** LCDIF_D14 **ALT3:** **ALT4:** GPIO0_IO14	3V3	
92	C24	SPI3_SDI	SPI3_SDI	**ALT0:** SPI3_SDI **ALT1:** **ALT2:** LCDIF_D15 **ALT3:** **ALT4:** 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	**ALT0:** SPI3_CS0 **ALT1:** MCLK_OUT1 **ALT2:** LCDIF_HSYNC **ALT3:** **ALT4:** GPIO0_IO16	3V3	
94	-	GND	-	-	-	
95	-	VDD_ENET0	-	-	VDD_ENET0	
96	A24	ENET0_RGMII_TXC	ENET0_RGMII_TXC	**ALT0:** ENET0_RGMII_TXC **ALT1:** ENET0_RCLK50M_OUT **ALT2:** ENET0_RCLK50M_IN **ALT3:** NAND_CE1_B **ALT4:** GPIO4_IO29	VDD_ENET0	
97	A23	ENET0_RGMII_TX_CTL	ENET0_RGMII_TX_CTL	**ALT0:** ENET0_RGMII_TX_CTL **ALT1:** **ALT2:** **ALT3:** USDHC1_RESET_B **ALT4:** GPIO4_IO30	VDD_ENET0	
98	A22	ENET0_RGMII_TXD0	ENET0_RGMII_TXD0	**ALT0:** ENET0_RGMII_TXD0 **ALT1:** **ALT2:** **ALT3:** USDHC1_VSELECT **ALT4:** GPIO4_IO31	VDD_ENET0	
99	A21	ENET0_RGMII_TXD1	ENET0_RGMII_TXD1	**ALT0:** ENET0_RGMII_TXD1 **ALT1:** **ALT2:** **ALT3:** USDHC1_WP **ALT4:** 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	**ALT0:** ENET0_RGMII_TXD2 **ALT1:** MLB_CLK **ALT2:** NAND_CE0_B **ALT3:** USDHC1_CD_B **ALT4:** GPIO5_IO01	VDD_ENET0	
101	A19	ENET0_RGMII_TXD3	ENET0_RGMII_TXD3	**ALT0:** ENET0_RGMII_TXD3 **ALT1:** MLB_SIG **ALT2:** NAND_RE_B **ALT3:** **ALT4:** GPIO5_IO02	VDD_ENET0	
102	A18	ENET0_RGMII_RXC	ENET0_RGMII_RXC	**ALT0:** ENET0_RGMII_RXC **ALT1:** MLB_DATA **ALT2:** NAND_WE_B **ALT3:** USDHC1_CLK **ALT4:** GPIO5_IO03	VDD_ENET0	
103	A17	ENET0_RGMII_RX_CTL	ENET0_RGMII_RX_CTL	**ALT0:** ENET0_RGMII_RX_CTL **ALT1:** **ALT2:** **ALT3:** USDHC1_CMD **ALT4:** GPIO5_IO04	VDD_ENET0	
104	A16	ENET0_RGMII_RXD0	ENET0_RGMII_RXD0	**ALT0:** ENET0_RGMII_RXD0 **ALT1:** **ALT2:** **ALT3:** USDHC1_DATA0 **ALT4:** GPIO5_IO05	VDD_ENET0	
105	A15	ENET0_RGMII_RXD1	ENET0_RGMII_RXD1	**ALT0:** ENET0_RGMII_RXD1 **ALT1:** **ALT2:** **ALT3:** USDHC1_DATA1 **ALT4:** 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	**ALT0:** ENET0_RGMII_RXD2 **ALT1:** ENET0_RMII_RX_ER **ALT2:** **ALT3:** USDHC1_DATA2 **ALT4:** GPIO5_IO07	VDD_ENET0	
107	A13	ENET0_RGMII_RXD3	ENET0_RGMII_RXD3	**ALT0:** ENET0_RGMII_RXD3 **ALT1:** **ALT2:** NAND_ALE **ALT3:** USDHC1_DATA3 **ALT4:** GPIO5_IO08	VDD_ENET0	
108	A12	ENET0_REFCLK_ 125M_25M	ENET0_REFCLK_125M_ 25M	**ALT0:** ENET0_REFCLK_125M_25M **ALT1:** ENET0_PPS **ALT2:** ENET1_PPS **ALT3:** **ALT4:** GPIO5_IO09	VDD_ENET0	
109	A11	ENET0_MDIO	ENET0_MDIO	**ALT0:** ENET0_MDIO **ALT1:** I2C3_SDA **ALT2:** ENET1_MDIO **ALT3:** **ALT4:** GPIO5_IO10	VDD_ENET0	
110	A10	ENET0_MDC	ENET0_MDC	**ALT0:** ENET0_MDC **ALT1:** I2C3_SCL **ALT2:** ENET1_MDC **ALT3:** **ALT4:** 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_TX_P	-	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	**ALT0:** ESAI0_SCKR **ALT1:** **ALT2:** LCDIF_D02 **ALT3:** ENET1_RGMII_TX_CTL **ALT4:** GPIO0_IO02	VDD_ESAI_SPDIF	
B20	ESAI0_FSR	ESAI0_FSR	**ALT0:** ESAI0_FSR **ALT1:** ENET1_RCLK50M_OUT **ALT2:** LCDIF_D00 **ALT3:** ENET1_RGMII_TXC **ALT4:** ENET1_RCLK50M_IN	VDD_ESAI_SPDIF	
B21	ESAI0_SCKT	ESAI0_SCKT	**ALT0:** ESAI0_SCKT **ALT1:** MLB_SIG **ALT2:** LCDIF_D03 **ALT3:** ENET1_RGMII_TXD3 **ALT4:** GPIO0_IO03	VDD_ESAI_SPDIF	
B22	ESAI0_TX1	ESAI0_TX1	**ALT0:** ESAI0_TX1 **ALT1:** **ALT2:** LCDIF_D05 **ALT3:** ENET1_RGMII_RXD3 **ALT4:** 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	**ALT0:** I2C1_SCL **ALT1:** USB_OTG2_PWR **ALT2:** **ALT3:** **ALT4:** GPIO4_IO04	3V3	
C8	USB_SS3_TC0	USB_SS3_TC0	**ALT0:** I2C1_SCL **ALT1:** USB_OTG1_PWR **ALT2:** USB_OTG2_PWR **ALT3:** **ALT4:** GPIO4_IO03	3V3	
C9	USB_SS3_TC2	USB_SS3_TC2	**ALT0:** I2C1_SDA **ALT1:** USB_OTG1_OC **ALT2:** USB_OTG2_OC **ALT3:** **ALT4:** GPIO4_IO05	3V3	
C10	USB_OTG2_ID	USB_OTG2_ID	-	3V3	
C11	USB_SS3_TC3	USB_SS3_TC3	**ALT0:** I2C1_SDA **ALT1:** USB_OTG2_OC **ALT2:** **ALT3:** **ALT4:** 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	**ALT0:** SPI2_CS0 **ALT1:** **ALT2:** **ALT3:** **ALT4:** GPIO1_IO00	VDD_SPI_SAI	
C18	SPI2_SDI	SPI2_SDI	**ALT0:** SPI2_SDI **ALT1:** **ALT2:** **ALT3:** **ALT4:** GPIO1_IO02	VDD_SPI_SAI	
C19	SAI0_TXFS	SAI0_TXFS	**ALT0:** SAI0_TXFS **ALT1:** SPI2_CS1 **ALT2:** SPI1_SCK **ALT3:** **ALT4:** GPIO0_IO28	VDD_SPI_SAI	
C20	ESAI0_TX2_RX3	ESAI0_TX2_RX3	**ALT0:** ESAI0_TX2_RX3 **ALT1:** ENET1_RMII_RX_ER **ALT2:** LCDIF_D06 **ALT3:** ENET1_RGMII_RXD2 **ALT4:** GPIO0_IO06	VDD_ESAI_SPDIF	
C21	ESAI0_FST	ESAI0_FST	**ALT0:** ESAI0_FST **ALT1:** MLB_CLK **ALT2:** LCDIF_D01 **ALT3:** ENET1_RGMII_TXD2 **ALT4:** 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	**ALT0:** ESAI0_TX4_RX1 **ALT1:** **ALT2:** LCDIF_D08 **ALT3:** ENET1_RGMII_TXD0 **ALT4:** GPIO0_IO08	VDD_ESAI_SPDIF	
C23	SPDIF0_TX	SPDIF0_TX	**ALT0:** SPDIF0_TX **ALT1:** MQS_L **ALT2:** LCDIF_D11 **ALT3:** ENET1_RGMII_RX_CTL **ALT4:** 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	**ALT0:** SPI0_SCK **ALT1:** SAI0_TXC **ALT2:** M40_I2C0_SCL **ALT3:** M40_GPIO0_IO00 **ALT4:** GPIO1_IO04	VDD_SPI_SAI	
D18	SPI2_SDO	SPI2_SDO	**ALT0:** SPI2_SDO **ALT1:** **ALT2:** **ALT3:** **ALT4:** GPIO1_IO01	VDD_SPI_SAI	
D19	SAI1_RXD	SAI1_RXD	**ALT0:** SAI1_RXD **ALT1:** SAI0_RXFS **ALT2:** SPI1_CS1 **ALT3:** LCDIF_D21 **ALT4:** GPIO0_IO29	VDD_SPI_SAI	
D20	ESAI0_TX5_RX0	ESAI0_TX5_RX0	**ALT0:** ESAI0_TX5_RX0 **ALT1:** **ALT2:** LCDIF_D09 **ALT3:** ENET1_RGMII_TXD1 **ALT4:** 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	**ALT0:** SPDIF0_RX **ALT1:** MQS_R **ALT2:** LCDIF_D10 **ALT3:** ENET1_RGMII_RXD0 **ALT4:** GPIO0_IO10	VDD_ESAI_SPDIF	
D22	ESAI0_TX0	ESAI0_TX0	**ALT0:** ESAI0_TX0 **ALT1:** MLB_DATA **ALT2:** LCDIF_D04 **ALT3:** ENET1_RGMII_RXC **ALT4:** GPIO0_IO04	VDD_ESAI_SPDIF	
D23	ESAI0_TX3_RX2	ESAI0_TX3_RX2	**ALT0:** ESAI0_TX3_RX2 **ALT1:** **ALT2:** LCDIF_D07 **ALT3:** ENET1_RGMII_RXD1 **ALT4:** GPIO0_IO07	VDD_ESAI_SPDIF	
D24	GND	-	-	-	
D25	SPDIF0_EXT_CLK	SPDIF0_EXT_CLK	**ALT0:** SPDIF0_EXT_CLK **ALT1:** **ALT2:** LCDIF_D12 **ALT3:** ENET1_REFCLK_125M_25M **ALT4:** 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	**ALT0:** UART1_RX **ALT1:** PWM1_OUT **ALT2:** GPT0_COMPARE **ALT3:** GPT1_CLK **ALT4:** 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	**ALT0:** UART1_TX **ALT1:** PWM0_OUT **ALT2:** GPT0_CAPTURE **ALT3:** **ALT4:** 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	**ALT0:** SPI2_SCK **ALT1:** **ALT2:** **ALT3:** **ALT4:** GPIO1_IO03	VDD_SPI_SAI	
E18	SPI0_SDO	SPI0_SDO	**ALT0:** SPI0_SDO **ALT1:** SAI0_TXFS **ALT2:** M40_I2C0_SDA **ALT3:** M40_GPIO0_IO01 **ALT4:** GPIO1_IO06	VDD_SPI_SAI	
E19	SPI0_CS0	SPI0_CS0	**ALT0:** SPI0_CS0 **ALT1:** SAI0_RXD **ALT2:** M40_TPM0_CH1 **ALT3:** M40_GPIO0_IO03 **ALT4:** 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	**ALT0:** SAI0_TXD **ALT1:** SAI1_RXC **ALT2:** SPI1_SDO **ALT3:** LCDIF_D18 **ALT4:** GPIO0_IO25	VDD_SPI_SAI	
E21	SAI0_RXD	SAI0_RXD	**ALT0:** SAI0_RXD **ALT1:** SAI1_RXFS **ALT2:** SPI1_CS0 **ALT3:** LCDIF_D20 **ALT4:** GPIO0_IO27	VDD_SPI_SAI	
E22	SPI0_SDI	SPI0_SDI	**ALT0:** SPI0_SDI **ALT1:** SAI0_TXD **ALT2:** M40_TPM0_CH0 **ALT3:** M40_GPIO0_IO02 **ALT4:** GPIO1_IO05	VDD_SPI_SAI	
E23	SAI0_TXC	SAI0_TXC	**ALT0:** SAI0_TXC **ALT1:** SAI1_TXD **ALT2:** SPI1_SDI **ALT3:** LCDIF_D19 **ALT4:** GPIO0_IO26	VDD_SPI_SAI	
E24	SAI1_RXC	SAI1_RXC	**ALT0:** SAI1_RXC **ALT1:** SAI1_TXC **ALT2:** **ALT3:** LCDIF_D22 **ALT4:** GPIO0_IO30	VDD_SPI_SAI	
E25	SAI1_RXFS	SAI1_RXFS	**ALT0:** SAI1_RXFS **ALT1:** SAI1_TXFS **ALT2:** **ALT3:** LCDIF_D23 **ALT4:** 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	**ALT0:** SPI0_CS1 **ALT1:** SAI0_RXC **ALT2:** SAI1_TXD **ALT3:** LCDIF_PWM0 **ALT4:** GPIO1_IO07	VDD_SPI_SAI	
F2	VDD_PCIE_DIG	-	-	VDD_PCIE_DGI/3V3_RF	
F4	PCIE_LGA_OUT_CTRL0_WAKE_B	-	**ALT0:** PCIE_CTRL0_WAKE_B **ALT4:** 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	-	**ALT0:** PCIE_CTRL0_CLKREQ_B **ALT4:** 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	-	**ALT0:** PCIE_CTRL0_PERST_B **ALT4:** 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	**ALT0:** QSPI0A_DATA3 **ALT4:** 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	**ALT0:** UART1_RTS_B **ALT1:** PWM2_OUT **ALT2:** LCDIF_D16 **ALT3:** GPT1_CAPTURE **ALT4:** 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	**ALT0:** UART1_CTS_B **ALT1:** PWM3_OUT **ALT2:** LCDIF_D17 **ALT3:** GPT1_COMPARE **ALT4:** 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	**ALT0:** QSPI0A_DATA1 **ALT4:** 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	**ALT0:** QSPI0A_DATA2 **ALT4:** 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	**ALT0:** QSPI0B_DATA3 **ALT1:** QSPI1A_DATA3 **ALT2:** KPP0_ROW0 **ALT3:** **ALT4:** GPIO3_IO21	VDD_QSPI0B	
AG9	QSPI0B_DATA1	QSPI0B_DATA1	**ALT0:** QSPI0B_DATA1 **ALT1:** QSPI1A_DATA1 **ALT2:** KPP0_COL2 **ALT3:** **ALT4:** GPIO3_IO19	VDD_QSPI0B	
AG10	QSPI0B_SS1_B	QSPI0B_SS1_B	**ALT0:** QSPI0B_SS1_B **ALT1:** QSPI1A_SS1_B **ALT2:** KPP0_ROW3 **ALT3:** **ALT4:** GPIO3_IO24	VDD_QSPI0B	
AG11	QSPI0B_DATA0	QSPI0B_DATA0	**ALT0:** QSPI0B_DATA0 **ALT1:** QSPI1A_DATA0 **ALT2:** KPP0_COL1 **ALT3:** **ALT4:** 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	**ALT0:** QSPI0B_DQS **ALT1:** QSPI1A_DQS **ALT2:** KPP0_ROW1 **ALT3:** **ALT4:** GPIO3_IO22	VDD_QSPI0B	
AG13	QSPI0B_SS0_B	QSPI0B_SS0_B	**ALT0:** QSPI0B_SSO_B **ALT1:** QSPI1A_SS0_B **ALT2:** KPP0_ROW2 **ALT3:** **ALT4:** GPIO3_IO23	VDD_QSPI0B	
AG14	QSPI0B_DATA2	QSPI0B_DATA2	**ALT0:** QSPI0B_DATA2 **ALT1:** QSPI1A_DATA2 **ALT2:** KPP0_COL3 **ALT3:** **ALT4:** GPIO3_IO20	VDD_QSPI0B	
AG15	QSPI0B_SCLK	QSPI0B_SCLK	**ALT0:** QSPI0B_SCLK **ALT1:** QSPI1A_SCLK **ALT2:** KPP0_COL0 **ALT3:** **ALT4:** 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	**ALT0:** ADC_IN4 **ALT1:** M40_TPM_CH0 **ALT2:** M40_GPIO0_IO04 **ALT3:** **ALT4:** GPIO1_IO14	1V8	
AG26	ADC_IN3	ADC_IN3	**ALT0:** ADC_IN3 **ALT1:** M40_UART0_TX **ALT2:** M40_GPIO0_IO03 **ALT3:** MCLK_OUT0 **ALT4:** GPIO1_IO11	1V8	
AG27	ADC_IN2	ADC_IN2	**ALT0:** ADC_IN2 **ALT1:** M40_UART0_RX **ALT2:** M40_GPIO0_IO02 **ALT3:** MCLK_IN0 **ALT4:** GPIO1_IO12	1V8	
AG28	ADC_IN5	ADC_IN5	**ALT0:** ADC_IN5 **ALT1:** TPM0_CH1 **ALT2:** M40_GPIO0_IO05 **ALT3:** **ALT4:** 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	-	-		Unless otherwise noted, tie this line to pad F29.
AH14	GND	-	-	-	

LGA pad name	ConnectCore 8X signal name	i.MX 8X pad name*	Multiplexing	Power Group	Comments
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	
AH17	GND	-	-	-	
AH18	NVCC_MIPI_CSI_DSI	-	-	NVCC_MIPI_CSI_DSI	
AH19	GND	-	-	-	
AH20	CSI_D06	CSI_D06	**ALT0:** CSI_D08 **ALT1:** **ALT2:** SAI3_RXC **ALT3:** TAMPER_IN1 **ALT4:**	VDD_CSI	
AH21	GND	-	-	-	
AH22	CSI_PCLK	CSI_PCLK	**ALT0:** CSI_PCLK **ALT1:** MIPI_CSI0_I2C0_SCL **ALT2:** **ALT3:** SPI1_SCK **ALT4:** GPIO3_IO00	VDD_CSI	
AH23	CSI_VSYNC	CSI_VSYNC	**ALT0:** CSI_VSYNC **ALT1:** CSI_D01 **ALT2:** **ALT3:** TAMPER_IN4 **ALT4:**	VDD_CSI	
AH24	CSI_D03	CSI_D03	**ALT0:** CSI_D05 **ALT1:** **ALT2:** SAI2_RXC **ALT3:** TAMPER_OUT3 **ALT4:**	VDD_CSI	

LGA pad name	ConnectCore 8X signal name	i.MX 8X pad name*	Multiplexing	Power Group	Comments
AH25	CSI_D00	CSI_D00	**ALT0:** CSI_D02 **ALT1:** **ALT2:** SAI0_RXC **ALT3:** TAMPER_OUT0 **ALT4:**	VDD_CSI	
AH26	CSI_D01	CSI_D01	**ALT0:** CSI_D03 **ALT1:** **ALT2:** SAI0_RXD **ALT3:** TAMPER_OUT1 **ALT4:**	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: ■ ON: high level. ■ OFF: low level. 2.2M pull-up on module connected to VCC_MCA.
AJ13	VCC_SNVS_LDO_1V8	-	-	VCC_SNVS_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	**ALT0:** CSI_MCLK **ALT1:** MIPI_CSI0_I2C0_SDA **ALT2:** **ALT3:** SPI1_SDO **ALT4:** GPIO3_IO01	VDD_CSI	
AJ22	CSI_D07	CSI_D07	**ALT0:** CSI_D09 **ALT1:** **ALT2:** SAI3_RXD **ALT3:** TAMPER_IN2 **ALT4:**	VDD_CSI	
AJ23	CSI_D04	CSI_D04	**ALT0:** CSI_D06 **ALT1:** **ALT2:** SAI2_RXD **ALT3:** TAMPER_OUT4 **ALT4:**	VDD_CSI	
AJ24	CSI_D05	CSI_D05	**ALT0:** CSI_D07 **ALT1:** **ALT2:** SAI2_RXFS **ALT3:** TAMPER_IN0 **ALT4:**	VDD_CSI	
AJ25	CSI_D02	CSI_D02	**ALT0:** CSI_D04 **ALT1:** **ALT2:** SAI0_RXFS **ALT3:** TAMPER_OUT2 **ALT4:**	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	**ALT0:** MIPI_CSI0_I2C0_SDA **ALT1:** MIPI_CSI0_GPIO0_IO03 **ALT2:** **ALT3:** **ALT4:** GPIO3_IO06	1V8	
AK25	MIPI_CSI0_I2C0_SCL	MIPI_CSI0_I2C0_SCL	**ALT0:** MIPI_CSI0_I2C0_SCL **ALT1:** MIPI_CSI0_GPIO0_IO02 **ALT2:** **ALT3:** **ALT4:** GPIO3_IO05	1V8	
AK26	CSI_RESET	CSI_RESET	**ALT0:** CSI_RESET **ALT1:** CSI_I2C_SDA **ALT2:** I2C3_SDA **ALT3:** SPI1_CS0 **ALT4:** GPIO3_IO03	VDD_CSI	
AK27	CSI_EN	CSI_EN	**ALT0:** CSI_EN **ALT1:** CSI_I2C_SCL **ALT2:** I2C3_SCL **ALT3:** SPI1_SDI **ALT4:** GPIO3_IO02	VDD_CSI	
AK28	CSI_HSYNC	CSI_HSYNC	**ALT0:** CSI_HSYNC **ALT1:** CSI_D00 **ALT2:** SAI3_RXFS **ALT3:** TAMPER_IN3 **ALT4:**	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	**ALT0:** MIPI_CSI0_MCLK_OUT **ALT1:** **ALT2:** **ALT3:** **ALT4:** 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	-	**ALT0:** **ALT1:** PTE0/CLKOUT32K **ALT2:** SPI1_MISO **ALT3:** LPUART1_TX **ALT4:** RTC_CLKOUT **ALT5:** CMP0_OUT **ALT6:** I2C1_SDA **ALT7:**	VCC_MCA	
AL22	MCA_IO13	-	**ALT0:** **ALT1:** PTD7 **ALT2:** SPI1_MISO **ALT3:** LPUART0_TX **ALT4:** I2C1_SCL **ALT5:** SPI1_MOSI **ALT6:** FXIO0_D7 **ALT7:**	VCC_MCA	
AL23	MCA_IO17	-	**ALT0:** **ALT1:** PTD4/LLWU_P14 **ALT2:** SPI1_PCS0 **ALT3:** UART2_RX **ALT4:** TPM0_CH4 **ALT5:** **ALT6:** FXIO0_D4 **ALT7:**	VCC_MCA	
AL24	MCA_IO16	-	**ALT0:** **ALT1:** PTC4/LLWU_P8 **ALT2:** SPI0_PCS0 **ALT3:** LPUART1_TX **ALT4:** TPM0_CH3 **ALT5:** SPI1_PCS0 **ALT6:** **ALT7:**	VCC_MCA	

LGA pad name	ConnectCore 8X signal name	i.MX 8X pad name*	Multiplexing	Power Group	Comments
AL25	MCA_IO15	-	**ALT0:** **ALT1:** PTC3 **ALT2:** SPI1_SCK **ALT3:** LPUART1_RX **ALT4:** TPM0_CH2 **ALT5:** CLKOUT **ALT6:** **ALT7:**	VCC_MCA	
AL26	MCA_IO14	-	**ALT0:** ADC0_SE11 **ALT1:** PTC2 **ALT2:** I2C1_SDA **ALT3:** **ALT4:** TPM0_CH1 **ALT5:** **ALT6:** **ALT7:**	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	-	**ALT0:** ADC0_SE7b **ALT1:** PTD6/LLWU_P15 **ALT2:** SPI1_MOSI **ALT3:** LPUART0_RX **ALT4:** I2C1_SDA **ALT5:** SPI1_MISO **ALT6:** FXIO0_D6 **ALT7:**	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	-	**ALT0:** ADC0_SE9 **ALT1:** PTB1 **ALT2:** I2C0_SDA **ALT3:** TPM1_CH1 **ALT4:** SPI1_MISO **ALT5:** SPI1_MOSI **ALT6:** **ALT7:**	VCC_MCA	
AM26	MCA_IO11	-	**ALT0:** ADC0_SE8 **ALT1:** PTB0/LLWU_P5 **ALT2:** I2C0_SCL **ALT3:** TPM1_CH0 **ALT4:** SPI1_MOSI **ALT5:** SPI1_MISO **ALT6:** **ALT7:**	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

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

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 (25ºC).

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 8XSystem-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[1] (mW)	Full SBC consumption[2] (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	-

[1] Measured at R1 on the SBC (input of VSYS+VSYS2)

[2] 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.

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

Assembly instructions

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.

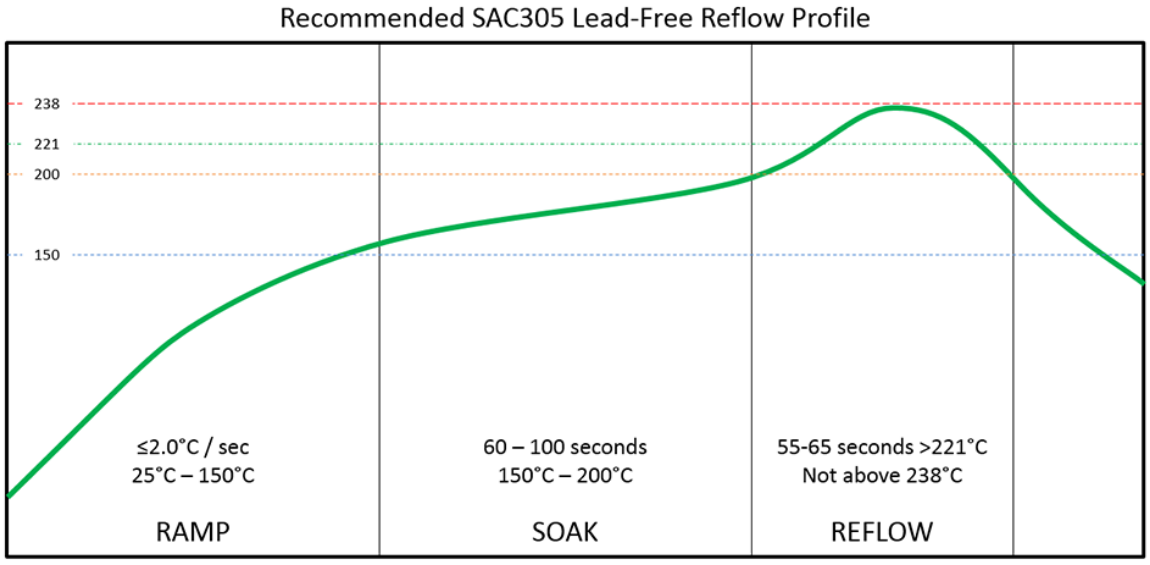
SMT process parameter reference

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 Reflow profile	

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

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

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	Channel bandwidth	Channel number (Center frequency, MHz)
2.4 GHz	2.5 dBi	BT + EDR Bluetooth LE	1	79 non-overlapping channels: 0 (2400) to 78 (2480)
			2	40 non-overlapping channels: 0 (2402) to 39 (2480)
		WLAN	20	1(2412), 2(2417), 3(2422), 4(2427), 5(2432), 6(2437), 7 (2442), 8(2447), 9 (2452), 10(2457), 11(2462)
			40	3(2422), 4(2427), 5(2432), 6(2437), 7(2442), 8(2447), 9 (2452)
5 GHz	4.6 dBi	WLAN	20	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), 149 (5745), 153(5765), 157(5785), 161(5805), 165(5825)
			40	38(5190), 46(5230), 54(5270), 62(5310), 102(5510), 110(5550), 118(5590), 126(5630), 134(5670), 151 (5755), 159(5795)
			80	42(5210), 58(5290), 106(5530), 122(5610), 155(5775)

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
PCB	TAOGLAS	FXP522.A.07.A.001	2402~2480	3.78 (Port 1) 3.15 (Port 2)	6.79
			5150~5250	4.63 (Port 1) 4.61 (Port 2)	7.64
			5250~5350	4.63 (Port 1) 4.61 (Port 2)	7.64
			5470~5725	4.63 (Port 1) 4.61 (Port 2)	7.64
			5725~5850	4.63 (Port 1) 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

Antenna type	Supplier	Antenna part no.	Freq. (MHz)	Peak antenna gain (dBi)	Directional gain (dBi)
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

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.

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.

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).

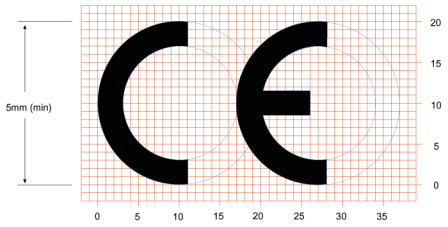
Furthermore, the manufacturer must maintain a copy of the ConnectCore 8X module user manual documentation and ensure the final product does not exceed the specified power ratings, antenna specifications, and/or installation requirements as specified in the user manual. If any of these specifications 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.

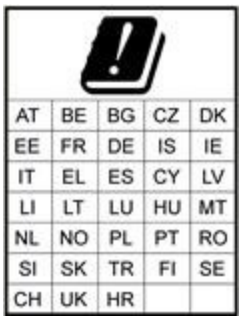
Important note

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



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

Radio Type / Description		Transmitter Frequency (MHz)	Maximum Output Power
Bluetooth	BR+EDR	2402 ~ 2480	15.86 dBm
	Low Energy	2402 ~ 2480	6.88 dBm
WLAN 2.4G	802.11b	2412 ~ 2472	19.24 dBm
	802.11g	2412 ~ 2472	19.31 dBm
	802.11n 20	2412 ~ 2472	19.54 dBm
	802.11n 40	2422 ~ 2462	19.45 dBm

Radio Type / Description		Transmitter Frequency (MHz)	Maximum Output Power
WLAN 5G	802.11a	5150 ~ 5350	22.16 dBm
		5470 ~ 5725	21.99 dBm
		5725 ~ 5850	13.17 dBm
	802.11n_20M 802.11ac_20M	5150 ~ 5350	22.22 dBm
		5470 ~ 5725	22.00 dBm
		5725 ~ 5850	13.16 dBm
	802.11n_40M 802.11ac_40M	5150 ~ 5350	22.55 dBm
		5470 ~ 5725	21.82 dBm
		5725 ~ 5850	13.28 dBm
	80211ac_80M	5150 ~ 5350	21.52 dBm
		5470 ~ 5725	20.90 dBm
		5725 ~ 5850	13.15 dBm

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:

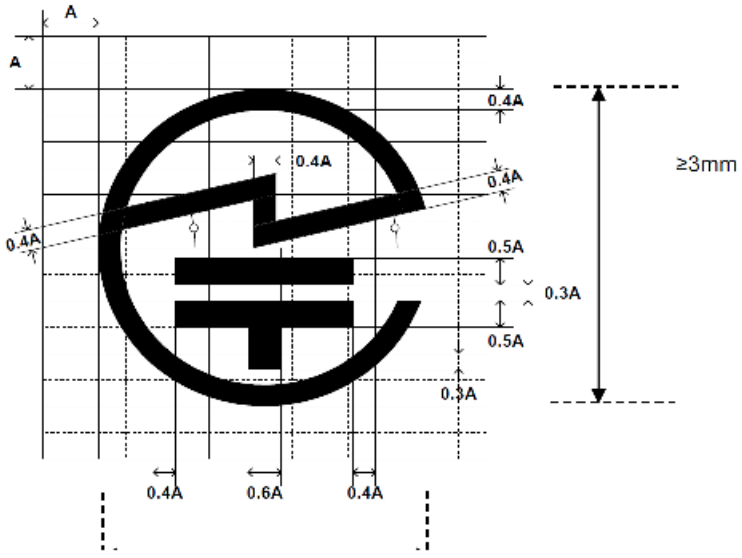
Ordinance concerning Technical Regulations Conformity Certification etc. of Specified Radio Equipment (特定無線設備の技術基準適合証明等に関する規則).

- 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).