AN14179

Migration Guide from MCXNx4x to MCXN23x

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Document information

Information	Content
Keywords	AN14179, MCXNx4x, MCXN23x, migration guide
Abstract	This application note describes the differences between MCXNx4x and MCXN23x and guides customers on how to quickly migrate applications from the MCXNx4x platform to the MCXN23x platform.

1 Introduction

The MCXNx4x is a new-generation MCU launched by NXP after Kinetis and LPC. It integrates excellent IP from both Kinetis and LPC platforms, such as CMC, FlexCAN, FlexIO, and SPC from the Kinetis platform and PowerQuad, SmartDMA, PINT, RTC, and MRT from the LPC platform. The MCX series MCU is divided into four subseries: N, A, L, and W.

- MCX N (Neural):
  - 150 MHz, 512KB-2MB
  - On-chip accelerators, enhanced peripherals, and advanced security
- MCX A (All-purpose):
  - Up to 96 MHz, 32KB-1MB
  - Intelligent peripherals and various device options for a wide range of applications
- MCX W (Wireless):
  - Up to 96 MHz
  - Low-power Bluetooth LE, Thread, and Zigbee radio optimized for IIoT and Matter applications and advanced security
- MCX L (Low-power):
  - Below 50 MHz, up to 1 MB
  - Optimized for always on battery operated applications with the lowest active power and leakage

The MCXNx4x series microcontrollers combine the Arm Cortex-M33 TrustZone core with a CoolFlux BSP32, a PowerQuad DSP Co-processor, and multiple high-speed connectivity options running at 150 MHz. To support a wide variety of applications, the MCX N series includes advanced serial peripherals, timers, high-precision analog, and state-of-the-art security features like secure user code, data, and communications. All MCXNx4x products include dual-bank flash, which supports read-while-write operation from internal flash. The MCXNx4x series also supports large external serial memory configurations.

The MCXNx4x MCU families are as follows:

- N54x: Mainstream MCU with a second M33 core, advanced timers, analog and high-speed connectivity, including high-speed USB, 10/100 Ethernet, and FlexIO, which can be programmed as an LCD controller.
- N94x: Integration of CPU and DSP serial connectivity, advanced timers, high precision analog, and high-speed connectivity, including high-speed USB, CAN 2.0, 10/100 Ethernet, and FlexIO, which can be programmed as an LCD controller.

MCXN23x is the second product in the MCX N series. It can be regarded as a cropped version of MCXNx4x. Almost all IPs are reused from MCXNx4x, and some co-processors and peripherals are removed. These removed modules are as follows:

- Co-processor: Secondary Cortex-M33 Core, PowerQuad, NPU, CoolFlux BSP32, and so on.
- Peripherals: FlexSPI, uSDHC, EMVSIM, Ethernet, 12-bit DAC, 14-bit DAC, and so on.

This document describes how to migrate applications from the MCXNx4x platform to the MCXN23x platform.

The system block diagram of MCXN23x is shown in Figure 1.

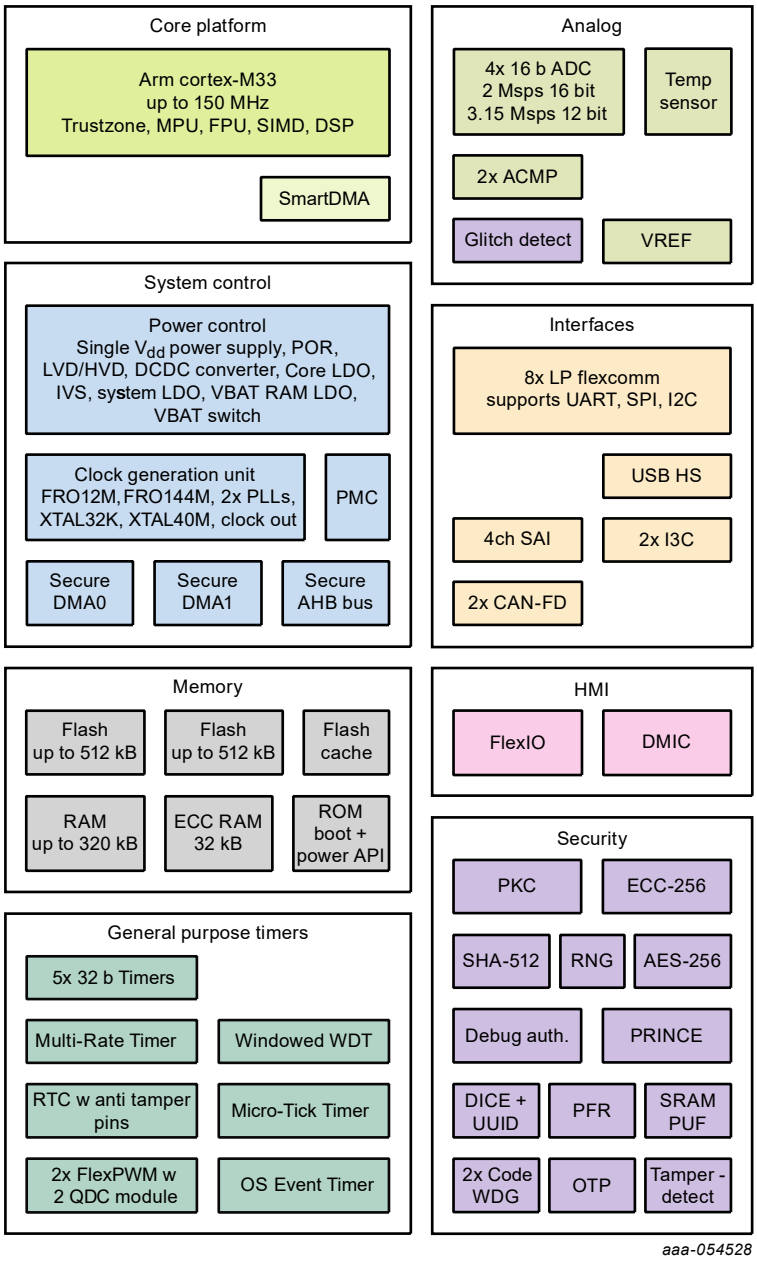


Figure 1. MCXN23x system block diagram

Table 1 lists the comparison of system resources between the MCXNx4x and MCXN23x.

Table 1. Comparison of MCXNx4x and MCXN23x

MCU series	MCXNx4x				MCXN23x	
Part	**MCXN947**	**MCXN946**	**MCXN547**	**MCXN546**	**MCXN236**	**MCXN235**
Package	VFBGA184 HLQFP100	VFBGA184 HLQFP100	VFBGA184 HLQFP100	VFBGA184 HLQFP100	VFBGA184 HLQFP100	VFBGA184 HLQFP100
Temp range (junction)	-40 ºC to 125 ºC	-40 ºC to 125 ºC	-40 ºC to 125 ºC	-40 ºC to 125 ºC	-40 ºC to 125 ºC	-40 ºC to 125 ºC

Table 1. Comparison of MCXNx4x and MCXN23x*...continued*

MCU series	MCXNx4x				MCXN23x	
Part	**MCXN947**	**MCXN946**	**MCXN547**	**MCXN546**	**MCXN236**	**MCXN235**
Core #1 Cortex-M33	150 MHz TZM +FPU+ETM	150 MHz TZM +FPU+ETM	150 MHz TZM +FPU+ETM	150 MHz TZM +FPU+ETM	150 MHz TZM +FPU+ETM	150 MHz TZM +FPU+ETM
Core #1 Cache	16 K	16 K	16 K	16 K	16 K	16 K
Core #2 Cortex-M33	150 MHz	150 MHz	150 MHz	150 MHz	-	-
PowerQuad (DSP and Cordic)	Y	Y	Y	Y	-	-
NPU	Y	Y	Y	Y	-	-
SmartDMA	Y	Y	Y	Y	Y	Y
CoolFlux BSP32	Y	Y	-	-	-	-
Total flash	2 MB	1 MB	2 MB	1 MB	1 MB	512 kB
Dual bank flash	Y	Y	Y	Y	Y	Y
Flash ECC and CRC	Y	Y	Y	Y	Y	Y
Flash encrypt (Prince)	Y	Y	Y	Y	Y	Y
SRAM (ECC user configurable)	480 K	320 K	480 K	320 K	320 K	160 K
SRAM with ECC (in addition to main SRAM)	32 K	32 K	32 K	32 K	32 K	32 K
FlexSPI with 16 k cache	1x, 2 ch	1x, 2 ch	1x, 2 ch	1x, 2 ch	-	-
uSDHC	Y[1]	-	Y	Y	-	-
EMVSIM	Y[1]	-	Y	Y	-	-
Secure key management	PUF/UDF	PUF/UDF	PUF/UDF	PUF/UDF	PUF/UDF	PUF/UDF
Secure subsystem	Y	Y	Y	Y	Y	Y
Anti-tamper pin[2]	8	8	8	8	6	6
Display controller (FlexIO)	1	1	1	1	1	1
TSI	1[1]	N	1	1	-	-
DMIC	4 ch[1]	-	4 ch	4 ch	4 ch	4 ch
SAI	4 ch	4 ch	4 ch	4 ch	4 ch	4 ch
LP_FLEXCOMM	10	10	10	10	8	8
I3C	2	2	2	2	2	2
USB HS	1	-	1	1	1	1
USB FS	1	1	1	1	-	-

Table 1. Comparison of MCXNx4x and MCXN23x*...continued*

MCU series	MCXNx4x				MCXN23x	
Part	**MCXN947**	**MCXN946**	**MCXN547**	**MCXN546**	**MCXN236**	**MCXN235**
10/100 Ethernet MAC	MII/RMII	MII/RMII	MII/RMII	MII/RMII	-	-
FlexCAN (FD)	2	2	1	1	2	2
DAC 12b, 1 Msps	2	2	1	1	-	-
DAC 14b, 5 Msps	1	1	-	-	-	-
Comparator	3	3	2	2	2	2
Opamp	3	3	-	-	-	-
ADC	2	2	2	2	2	2
VREF	Y	Y	Y	Y	Y	Y
FlexPWM	2	2	1	1	2	2
Quadrature Decoder	2	2	1	1	2	2
SINC filter	Y	Y	-	-	-	-
RTC	1	1	1	1	1	1
32b timer	5	5	5	5	5	5
SCTimer	1	1	1	1	-	-
MRT 24b	1	1	1	1	1	1
uTick timer	1	1	1	1	1	1
WWDT	1	1	1	1	1	1
OS timer	1	1	1	1	1	1

[1] This feature is only supported on the MCXN947 VFBGA184 package.
[2] The 100HLQFP supports two Anti-tamper pins.

The following section compares the MCXNx4x and MCXN23x in terms of memory, clock, pinout, and peripherals.

2 Memory

This section provides details about flash memory and SRAM memory.

2.1 Flash memory

The MCXNx4x has a flash size of up to 2 MB, while the MCXN23x has a flash size of up to 1 MB, both support dual bank flash and dual image boot. The configuration of flash size for each part is listed in Table 2 and Table 3.

Table 2. MCXNx4x part list

Part Number	Embedded memory		Features			Package	
	Flash (MB)	**SRAM (kB)**	**Tamper pins (max)**	**GPIOs (max)**	**SRAM PUF**	**Pin count**	**Type**
(P)MCXN547VNLT	2	512	2	74	Y	100	HLQFP

Table 2. MCXNx4x part list*...continued*

Part Number	Embedded memory		Features			Package	
	Flash (MB)	SRAM (kB)	Tamper pins (max)	GPIOs (max)	SRAM PUF	Pin count	Type
(P)MCXN546VNLT	1	352	2	74	Y	100	HLQFP
(P)MCXN547VDFT	2	512	8	124	Y	184	VFBGA
(P)MCXN546VDFT	1	352	8	124	Y	184	VFBGA
(P)MCXN947VDFT	2	512	8	124	Y	184	VFBGA
(P)MCXN947VNLT	2	512	2	78	Y	100	HLQFP
(P)MCXN946VNLT	1	352	2	78	Y	100	HLQFP
(P)MCXN946VDFT	1	352	8	124	Y	184	VFBGA

Table 3. MCXN23x part list

Part Number	Embedded Memory		Features			Package	
	Flash (MB)	SRAM (kB)	Tamper pins (max)	GPIOs (max)	SRAM PUF	Pin count	Type
(P)MCXN236VNLT	1	352	6	74	Y	100	HLQFP
(P)MCXN236VDFT	1	352	6	108	Y	184	VFBGA
(P)MCXN235VNLT	0.512	192	6	74	Y	100	HLQFP
(P)MCXN235VDFT	0.512	192	6	108	Y	184	VFBGA

2.2 SRAM memory

The RAM size of the MCXNx4x is up to 512 kB, and the RAM size of the MCXN23x is up to 352 kB. The size of flash and RAM for each part of the MCXNx4x and MCXN23x is listed in Table 4.

Table 4. Flash and RAM size of different parts

Parts		MCXNx47	MCXNx46	MCXN236	MCXN235
Flash		2M	1M	1M	512 kB
SRAM (kB)	Total size	512	352	352	192
	SRAMX	96 (0x04000000-0x04017FFF)	96 (0x04000000-0x04017FFF)	96 (0x04000000-0x04017FFF)	32 (0x04000000-0x04007FFF)
	SRAMA	32 (0x20000000-0x20007FFF)	32 (0x20000000-0x20007FFF)	32 (0x20000000-0x20007FFF)	32 (0x20000000-0x20007FFF)
	SRAMB	32 (0x20008000-0x2000FFFF)	32 (0x20008000-0x2000FFFF)	32 (0x20008000-0x2000FFFF)	32 (0x20008000-0x2000FFFF)
	SRAMC	64 (0x20010000-0x2001FFFF)	64 (0x20010000-0x2001FFFF)	64 (0x20010000-0x2001FFFF)	64 (0x20010000-0x2001FFFF)
	SRAMD	64 (0x20020000-0x2002FFFFF)	64 (0x20020000-0x2002FFFFF)	64 (0x20020000-0x2002FFFFF)	64 (0x20020000-0x2002FFFFF)
	SRAME	64 (0x20030000-0x2003FFFFF)	64 (0x20030000-0x2003FFFFF)	64 (0x20030000-0x2003FFFFF)	64 (0x20030000-0x2003FFFFF)

Table 4. Flash and RAM size of different parts*...continued*

Parts		MCXNx47	MCXNx46	MCXN236	MCXN235
	SRAMF	64 (0x20040000-0x2004FFFFF)	-	-	-
	SRAMG	64 (0x20050000-0x2005FFFFF)	-	-	-
	SRAMH	32 (0x20060000-0x20067FFF)	-	-	-

3 Clock system

The MCXN23x and MCXNx4x use almost the same clock system, with a few differences.

3.1 FRG

A Fractional Rate Generator (FRG) is added to the MCXN23x to generate a more accurate clock for the CLKOUT divider. The FRG output is used as the input of the CLKOUT divider, see Figure 2. It can be used to obtain more precise baud rates when the function clock is not a multiple of standard baud rates. This can be primarily used to create a base baud rate clock for USART functions, and can be used for other purposes, such as metering applications.

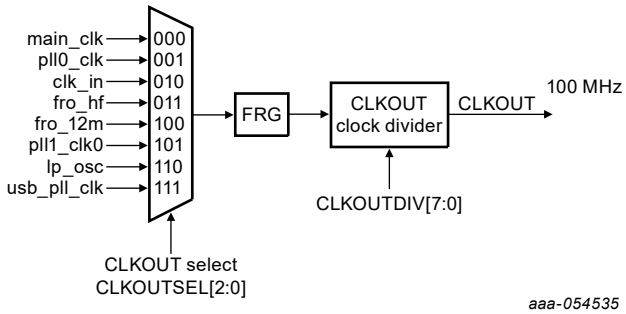


Figure 2. MCXN23x CLKOUT diagram

For the CLKOUT diagram of the MCXNx4x, see Figure 3.

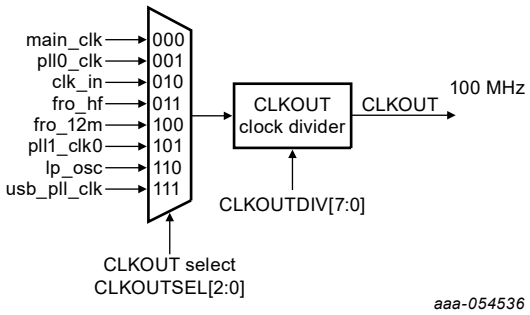


Figure 3. MCXNx4x CLKOUT diagram

The `CLKOUT_FRGCTRL` register has been added to the SYSCON module of MCXN23x and used to configure numerator and denominator values.

3.2 UTICK

The clock sources of UTICK (Micro-Tick) on the MCNX23x have been expanded from 1 to 3, and `xtal32k[2]` and `clk_in` have been added as clock sources of UTICK. The clock source of UTICK on the MCXN23x is shown in Figure 4.

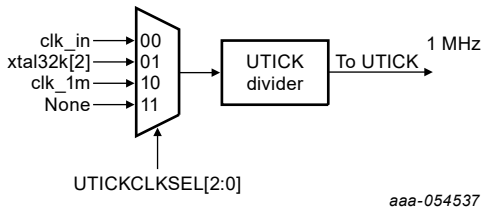


Figure 4. MCXN23x UTICK clock source

In the metering application, UTICK is used to measure power line frequency. To support metering applications, `clk_in` and `xtal32k[2]` are added to the MCXN23x for high-accuracy clock source.

3.3 I3C

The clock diagram of I3C on the MCXN23x is shown in Figure 5.

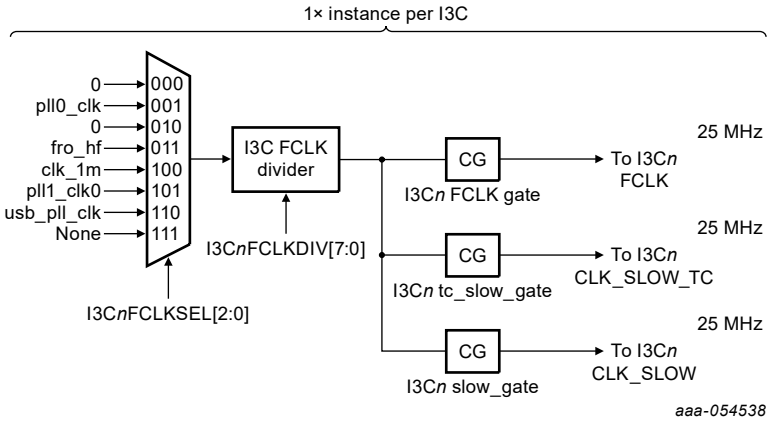


Figure 5. MCXN23x I3C clock diagram

Add `clk_1m` as the clock source to the `I3C_FCLK` divider, and keep `CLK_SLOW` and `CLK_SLOW_TC` synchronized with `FCLK`.

The I3C clock diagram of MCXNx4x is shown in Figure 6.

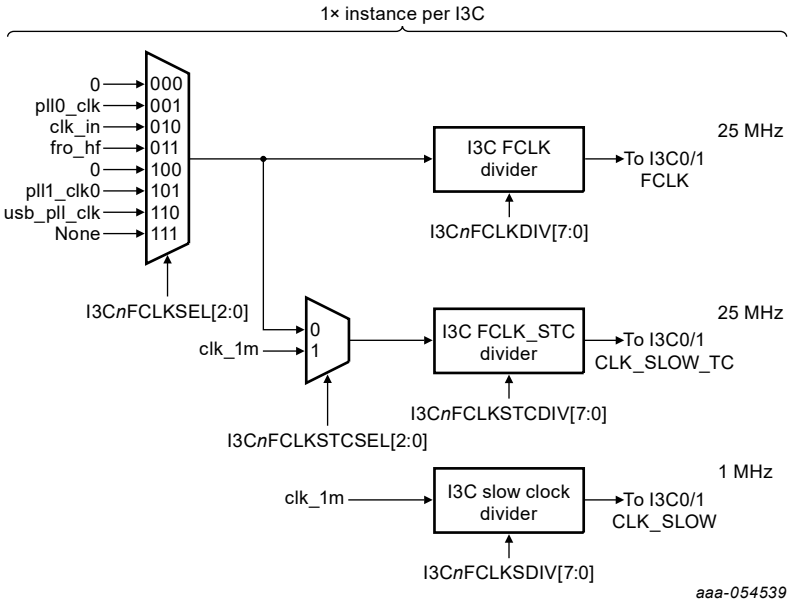


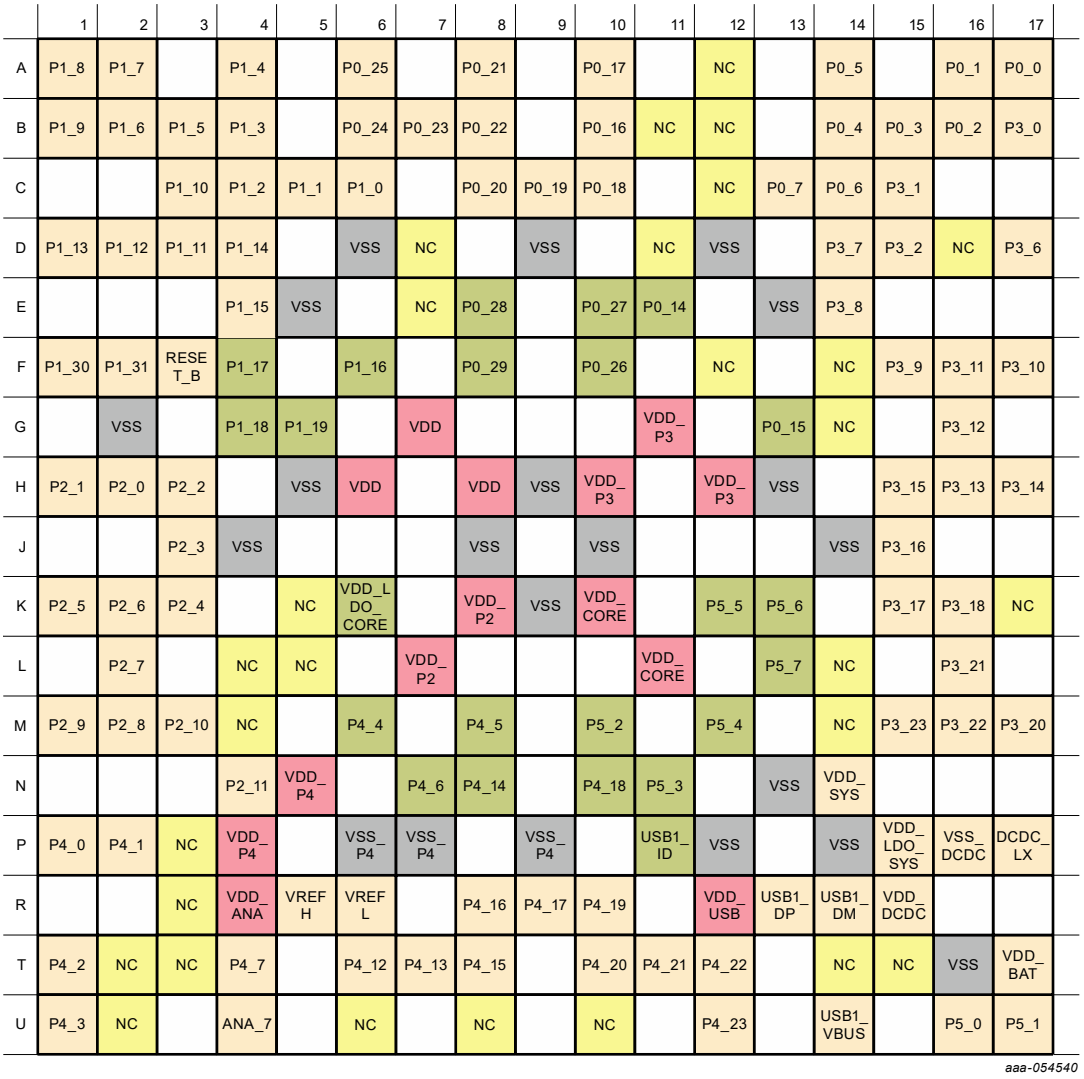
Figure 6. MCXNx4x I3C clock diagram

4 Pinout

This section compares the pinout differences between MCXNx4x and MCXN23x, including 184VFBGA and 100HLQFP packages.

4.1 184VFBGA

For the 184VFBGA package, the MCXN23x is pin-to-pin compatible with the MCXNx4x. However, there are some differences between the two. In MCXN23x, 28 pins are removed, including 18 GPIO pins, eight analog pins, and two USB pins. The pinout of the MCXN23x 184VFBGA package is illustrated in Figure 7.



	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
A	P1_8	P1_7		P1_4		P0_25		P0_21		P0_17		NC		P0_5		P0_1	P0_0
B	P1_9	P1_6	P1_5	P1_3		P0_24	P0_23	P0_22		P0_16	NC	NC		P0_4	P0_3	P0_2	P3_0
C			P1_10	P1_2	P1_1	P1_0		P0_20	P0_19	P0_18		NC	P0_7	P0_6	P3_1		
D	P1_13	P1_12	P1_11	P1_14		VSS	NC		VSS		NC	VSS		P3_7	P3_2	NC	P3_6
E				P1_15	VSS		NC	P0_28		P0_27	P0_14		VSS	P3_8			
F	P1_30	P1_31	RESET_B	P1_17		P1_16		P0_29		P0_26		NC		NC	P3_9	P3_11	P3_10
G		VSS		P1_18	P1_19		VDD				VDD_P3		P0_15	NC		P3_12	
H	P2_1	P2_0	P2_2		VSS	VDD		VDD	VSS	VDD_P3		VDD_P3	VSS		P3_15	P3_13	P3_14
J			P2_3	VSS				VSS		VSS				VSS	P3_16		
K	P2_5	P2_6	P2_4		NC	VDD_LDO_CORE		VDD_P2	VSS	VDD_CORE		P5_5	P5_6		P3_17	P3_18	NC
L		P2_7		NC	NC		VDD_P2				VDD_CORE		P5_7	NC		P3_21	
M	P2_9	P2_8	P2_10	NC		P4_4		P4_5		P5_2		P5_4		NC	P3_23	P3_22	P3_20
N				P2_11	VDD_P4		P4_6	P4_14		P4_18	P5_3		VSS	VDD_SYS			
P	P4_0	P4_1	NC	VDD_P4		VSS_P4	VSS_P4		VSS_P4		USB1_ID	VSS		VSS	VDD_LDO_SYS	VSS_DCDC	DCDC_LX
R			NC	VDD_ANA	VREFH	VREFL		P4_16	P4_17	P4_19		VDD_USB	USB1_DP	USB1_DM	VDD_DCDC		
T	P4_2	NC	NC	P4_7		P4_12	P4_13	P4_15		P4_20	P4_21	P4_22		NC	NC	VSS	VDD_BAT
U	P4_3	NC		ANA_7		NC		NC		NC		P4_23		USB1_VBUS		P5_0	P5_1

aaa-054540

Figure 7. MCXN23x 184VFBGA pinout

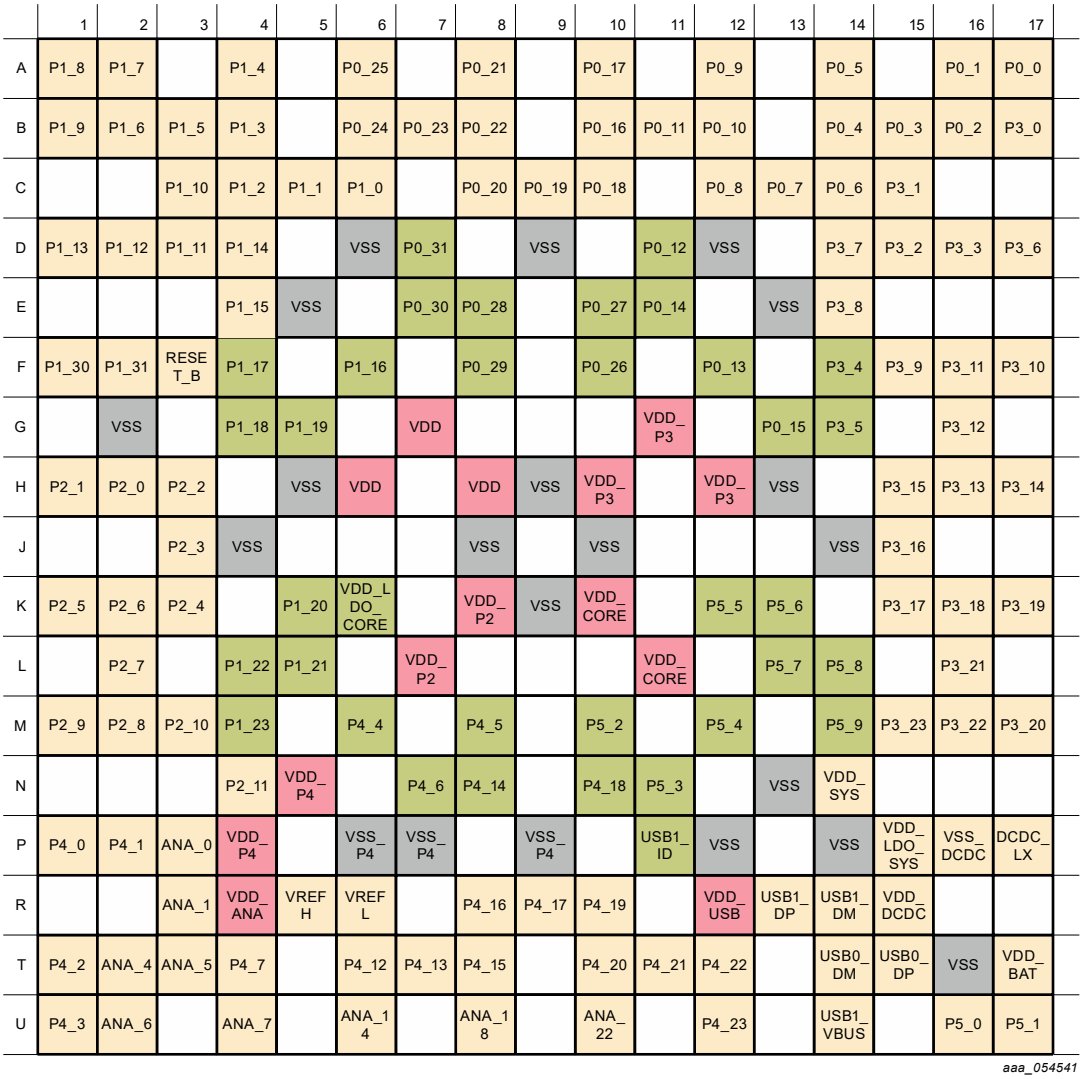
In Figure 7, the removed pins are labeled "NC" and are highlighted in yellow.

The removed pins on the MCXN23x 184VFBGA are as follows:

- GPIO pins:
  - P0_8
  - P0_9
  - P0_10
  - P0_11
  - P0_12
  - P0_13
  - P0_30
  - P0_31
  - P1_20
  - P1_21
  - P1_22
  - P1_23

  - P3_3
  - P3_4
  - P3_5
  - P3_19
  - P5_8
  - P5_9
- Analog pins:
  - ANA_0
  - ANA_1
  - ANA_4
  - ANA_5
  - ANA_6
  - ANA_14
  - ANA_18
  - ANA_22
- USB pins:
  - USB0_DM
  - USB0_DP

The pinout of the MCXNx4x 184VFBGA package is shown in Figure 8.



	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
A	P1_8	P1_7		P1_4		P0_25		P0_21		P0_17		P0_9		P0_5		P0_1	P0_0
B	P1_9	P1_6	P1_5	P1_3		P0_24	P0_23	P0_22		P0_16	P0_11	P0_10		P0_4	P0_3	P0_2	P3_0
C			P1_10	P1_2	P1_1	P1_0		P0_20	P0_19	P0_18		P0_8	P0_7	P0_6	P3_1		
D	P1_13	P1_12	P1_11	P1_14		VSS	P0_31		VSS		P0_12	VSS		P3_7	P3_2	P3_3	P3_6
E				P1_15	VSS		P0_30	P0_28		P0_27	P0_14		VSS	P3_8			
F	P1_30	P1_31	RESET_B	P1_17		P1_16		P0_29		P0_26		P0_13		P3_4	P3_9	P3_11	P3_10
G		VSS		P1_18	P1_19		VDD				VDD_P3		P0_15	P3_5		P3_12	
H	P2_1	P2_0	P2_2		VSS	VDD		VDD	VSS	VDD_P3		VDD_P3	VSS		P3_15	P3_13	P3_14
J			P2_3	VSS				VSS		VSS				VSS	P3_16		
K	P2_5	P2_6	P2_4		P1_20	VDD_LDO_CORE		VDD_P2	VSS	VDD_CORE		P5_5	P5_6		P3_17	P3_18	P3_19
L		P2_7		P1_22	P1_21		VDD_P2				VDD_CORE		P5_7	P5_8		P3_21	
M	P2_9	P2_8	P2_10	P1_23		P4_4		P4_5		P5_2		P5_4		P5_9	P3_23	P3_22	P3_20
N				P2_11	VDD_P4		P4_6	P4_14		P4_18	P5_3		VSS	VDD_SYS			
P	P4_0	P4_1	ANA_0	VDD_P4		VSS_P4	VSS_P4		VSS_P4		USB1_ID	VSS		VSS	VDD_LDO_SYS	VSS_DCDC	DCDC_LX
R			ANA_1	VDD_ANA	VREFH	VREFL		P4_16	P4_17	P4_19		VDD_USB	USB1_DP	USB1_DM	VDD_DCDC		
T	P4_2	ANA_4	ANA_5	P4_7		P4_12	P4_13	P4_15		P4_20	P4_21	P4_22		USB0_DM	USB0_DP	VSS	VDD_BAT
U	P4_3	ANA_6		ANA_7		ANA_14		ANA_18		ANA_22		P4_23		USB1_VBUS		P5_0	P5_1

aaa_054541

Figure 8. MCXNx4x 184VFBGA pinout

4.2 100HLQFP

For the 100HLQFP package, MCXN23x is almost pin-to-pin compatible with MCXN54x. The only difference is the USB pin. The MCXN54x supports full-speed USB (`USB0`) and high-speed USB (`USB1`), but the MCXN23x only supports `USB1`, so the MCXN23x does not have `USB0_DM` and `USB0_DP` pins. The pinout of the MCXN23x 100HLQFP package is as shown in Figure 9.

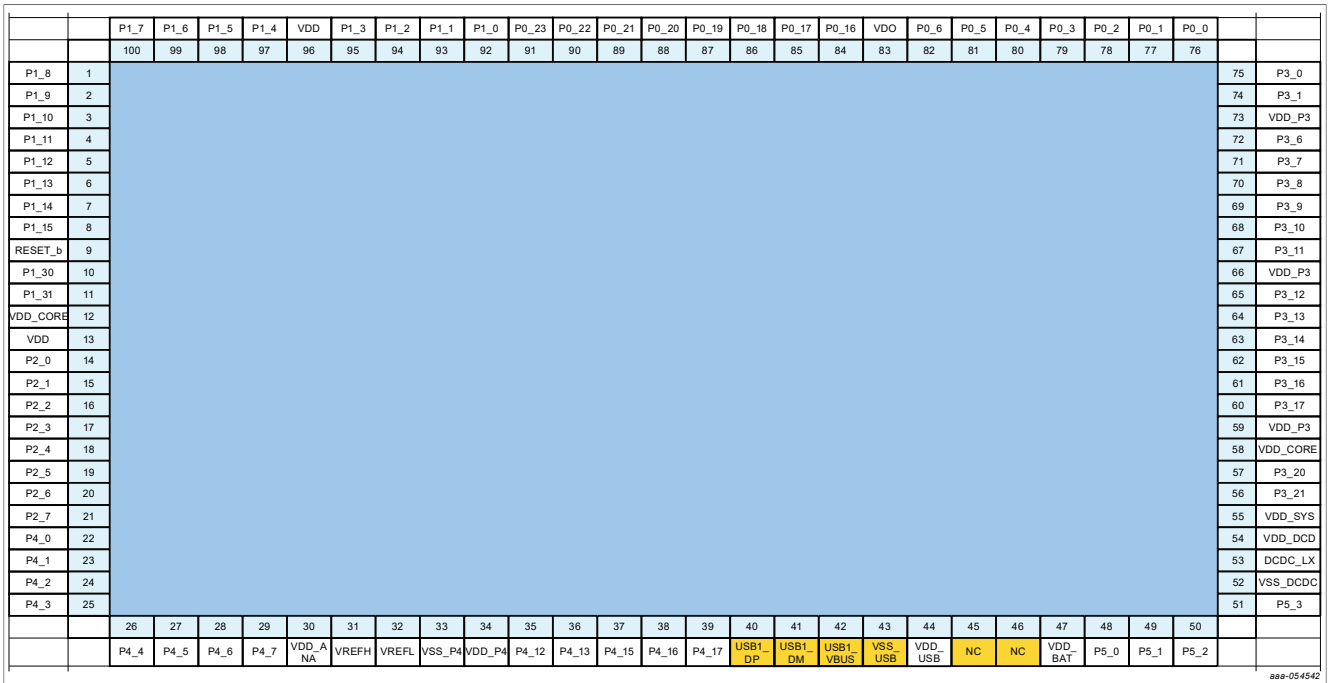


Figure 9. MCXN23x 100HLQFP pinout

The pinout of the MCXN54x and MCXN94x 100HLQFP package is shown in Figure 10.

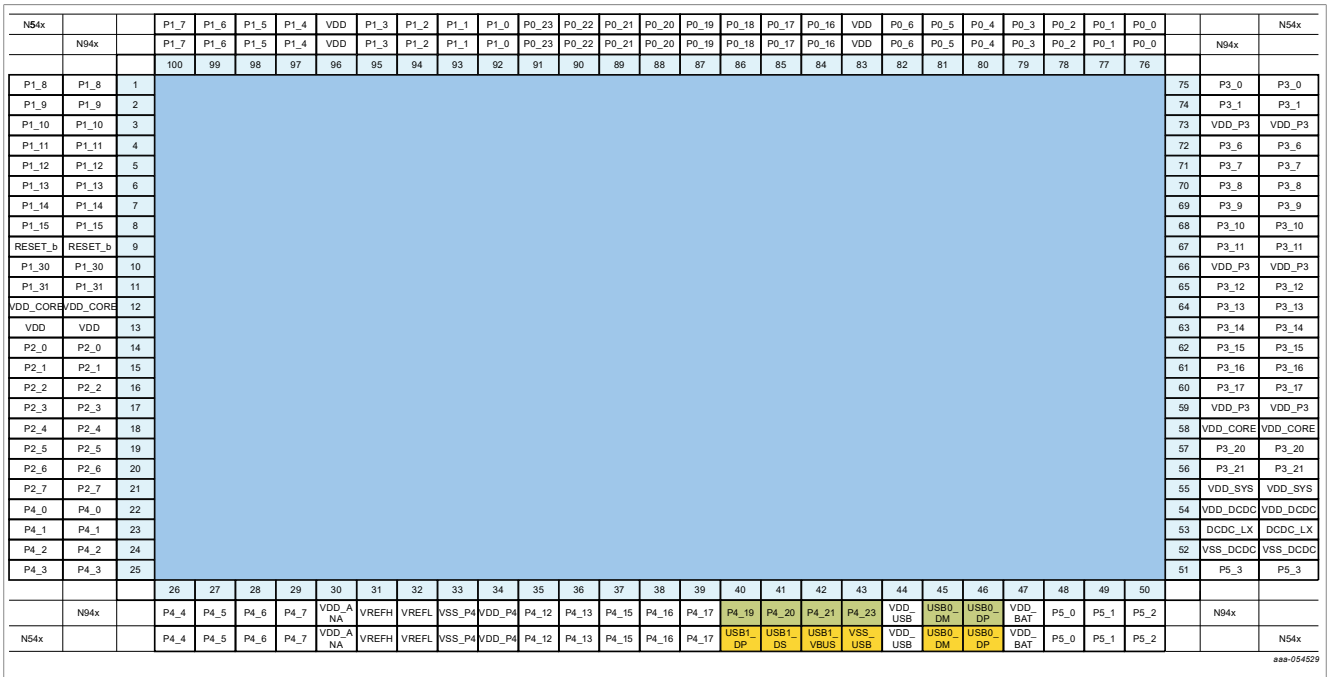


Figure 10. MCXN94x and MCXN54x 100HLQFP pinout

MCXN94x has six pins `P4_19`, `P4_20`, `P4_21`, `P4_23`, `USB0_DM`, and `USB0_DP`. However, MCXN23x does not have these six pins but instead has four different pins `USB1_DP`, `USB1_DM`, `USB1_VBUS`, and `VSS_USB`.

For more detailed information about the pinouts, refer to the pinout table in the attachments of *MCX Nx4x Reference Manual* (document MCXNX4XRM) and *MCXN23x Reference Manual* (document MCXN23XRM).

5 Peripherals

In Table 1, we have compared the differences between MCNX23x and MCXNx4x. The MCXN23x does not have various modules such as FlexSPI, PowerQuad, NPU, CoolFlux BSP32, uSDHC, EMVSIM, TSI, USB FS, Ethernet, 12-bit DAC, 14-bit DAC, Opamp, SINC Filter, and SCTimer. The following section describes the differences between the common peripherals between the MCXN23x and MCXNx4x.

5.1 GPIO

As described in Section 4.1, the MCXNx4x supports up to 124 GPIOs, and the MCXN23x supports up to 106 GPIOs. However, in the case of MCXN23x, 18 GPIO pins are not supported. Apart from being used as GPIOs, these 16 pins also support the functions listed in Table 5.

Table 5. Removed GPIOs on the MCXN23x 184VFBGA package

184BGA ALL	184BGA ALL Pin Name	Analog	ALT0	ALT1	ALT2	ALT3	ALT4	ALT5	ALT6	ALT7	ALT10	ALT11
K5	P1_20	ADC1_A20/ CMP1_IN3	P1_20	TRIG_IN2	FC5_P4	FC4_P0	CT3_MAT2	SCT0_ OUT8	FLEXIO0_ D28	SmartDMA_ PIO16	-	CAN1_TXD
L5	P1_21	ADC1_A21/ CMP2_IN3	P1_21	TRIG_OUT2	FC5_P5	FC4_P1	CT3_MAT3	SCT0_ OUT9	FLEXIO0_ D29	SmartDMA_ PIO17	SAI1_ MCLK	CAN1_RXD
L4	P1_22	ADC1_A22	P1_22	TRIG_IN3	FC5_P6	FC4_P2	CT_INP14	SCT0_ OUT4	FLEXIO0_ D30	SmartDMA_ PIO18	-	-
M4	P1_23	ADC1_A23	P1_23	-	-	FC4_P3	CT_INP15	SCT0_ OUT5	FLEXIO0_ D31	SmartDMA_ PIO19	-	-
L14	P5_8	ADC1_B16	P5_8	TRIG_OUT7	-	TAMPER6	-	-	-	-	-	-
M14	P5_9	ADC1_B17	P5_9		-	TAMPER7	-	-	-	-	-	-
K17	P3_19	-	P3_19	-	FC7_P6	-	CT2_MAT1	PWM1_X1	FLEXIO0_ D27	SmartDMA_ PIO19	SAI1_RX_ FS	-
G14	P3_5	-	P3_5	-	FC7_P3	-	CT_INP19	PWM0_X3	FLEXIO0_ D13	SmartDMA_ PIO5	-	-
F14	P3_4	-	P3_4	-	FC7_P2	-	CT_INP18	PWM0_X2	FLEXIO0_ D12	SmartDMA_ PIO4	-	-
D16	P3_3	-	P3_3	-	FC7_P1	-	CT4_MAT1	PWM0_X1	FLEXIO0_ D11	SmartDMA_ PIO3	-	-
C12	P0_8	ADC0_B8	P0_8	-	FC0_P4	-	CT_INP0	-	FLEXIO0_ D0	-	-	-
A12	P0_9	ADC0_B9	P0_9	-	FC0_P5	-	CT_INP1	-	FLEXIO0_ D1	-	-	-
B12	P0_10	ADC0_B10	P0_10	-	FC0_P6	-	CT0_MAT0	-	FLEXIO0_ D2	-	-	-
B11	P0_11	ADC0_B11	P0_11	-	-	-	CT0_MAT1	-	FLEXIO0_ D3	-	-	-
D11	P0_12	ADC0_B12	P0_12	-	FC1_P4	FC0_P0	CT0_MAT2	-	FLEXIO0_ D4	-	-	-
F12	P0_13	ADC0_B13	P0_13	-	FC1_P5	FC0_P1	CT0_MAT3	-	FLEXIO0_ D5	-	-	-
E7	P0_30	ADC0_B22	P0_30	-	FC1_P6	FC0_P6	CT_INP2	-	-	-	-	-
D7	P0_31	ADC0_B23	P0_31	-	-	-	CT_INP3	-	-	-	-	-

Table 5 lists the specific pins, including LP_FLEXCOMM0/1/4/5/7, TRIG, CTimer, FlexPWM, FlexIO, SmartDMA, and SAI1 are involved. However, the other pins on the MCX23x can also implement the same functions as these pins. Before migrating from the MCXNx4x to MCXN23x, it is important to check if your design on the MCXNx4x uses these pins. If it does, you must reassign the pins to meet your requirements.

5.2 USB

All the MCXN54x parts and the MCXN94x 184VFBGA packages support FS USB (USB0) and HS USB (USB1). Whereas the MCXN94x 100HLQFP package only supports HS USB. All the MCXN23x parts only support HS USB.

5.3 DMIC

All parts of the MCXN23x and MCXN54x have a DMIC module and support up to four digital microphone channels. However, for the MCXN94x series, the MCXN946 does not support the DMIC module, and the MCXN947 only supports the DMIC module on the 184VFBGA package.

5.4 LP_FLEXCOMM

The MCXNx4x series supports 10 LP_FLEXCOMM modules. Each LP_FLEXCOMM can be configured as UART, I2C, and SPI. Among them, the IO of LP_FLEXCOMM6/7/8/9 is high-speed IO, and the highest clock that can be configured is 150 MHz. The MCXN23x only supports eight LP_FLEXCOMM modules and does not support LP_FLEXCOMM8 and LP_FLEXCOMM9, only LP_FLEXCOMM6 and LP_FLEXCOMM7 can use high-speed IOs.

5.5 Comparator

The MCXN94x series supports three Comparator (CMP) modules, while the MCXN54x and MCXN23x series only support two CMP modules.

5.6 ADC

The MCXNx4x and MCXN23x series have two 16-bit ADC modules but differ in the number of ADC channels they support. The MCXNx4x can support up to 75 ADC channels, while the MCXN23x can support up to 63 ADC channels. For the 184VFBGA package, the MCXN23x cannot support the 12 ADC channels listed in Table 6 because the 16 pins mentioned in Table 6 are removed.

Table 6. Removed ADC channels on MCXN23x

184BGA ALL Pin Name	Analog
P1_20	ADC1_A20/CMP1_IN3
P1_21	ADC1_A21/CMP2_IN3
P1_22	ADC1_A22
P1_23	ADC1_A23
P5_8	ADC1_B16
P5_9	ADC1_B17
P3_19	-
P3_5	-
P3_4	-
P3_3	-
P0_8	ADC0_B8
P0_9	ADC0_B9
P0_10	ADC0_B10
P0_11	ADC0_B11

Table 6. Removed ADC channels on MCXN23x*...continued*

184BGA ALL Pin Name	Analog
P0_12	ADC0_B12
P0_13	ADC0_B13
P0_30	ADC0_B22
P0_31	ADC0_B23

Note: *The term ADC channels refer to the external ADC input channels.*

5.7 FlexPWM and Quadrature Decoder (QDC)

The MCXN94x and MCXN23x are compatible with dual-motor applications as they support two FlexPWM modules and two QDC modules. But, the MCXN54x supports only one FlexPWM module and one QDC module, making it suitable for single-motor solutions only.

5.8 DMA

The MCXNx4X has two eDMA modules, `eDMA0` and `eDMA1`. Each module supports 16 DMA channels. The MCXN23x also has 2 eDMA modules, but `eDMA1` only supports eight channels.

5.9 Anti-tamper pin

The tamper pins for MCXNx4x are listed in Table 7 and Table 8. The MCXNx4x has eight tamper pins, and the MCXN23x has six tamper pins. Pin `P5_8` and `P5_9` are removed on MCXN23x.

Note: *The 100HLQFP packaged parts of MCXN4x and MCXN23x only support two tamper pins.*

Table 7. Tamper pins on MCXNx4x

184BGA all	184VFBGA pin name	100HLQFP N94x	100HLQFP N94x pin name	100HLQFP N54x	100HLQFP N54x pin name	ALT0	ALT3
M10	P5_2	50	P5_2	50	P5_2	P5_2	TAMPER0
N11	P5_3	51	P5_3	51	P5_3	P5_3	TAMPER1
M12	P5_4	-	-	-	-	P5_4	TAMPER2
K12	P5_5	-	-	-	-	P5_5	TAMPER3
K13	P5_6	-	-	-	-	P5_6	TAMPER4
L13	P5_7	-	-	-	-	P5_7	TAMPER5
L14	P5_8	-	-	-	-	P5_8	TAMPER6
M14	P5_9	-	-	-	-	P5_9	TAMPER7

Table 8. Tamper pins on MCXN23x

184BGA ball	184VFBGA pin name	100HLQFP	100HLQFP pin name	ALT0	ALT3
M10	P5_2	50	P5_2	P5_2	TAMPER0
N11	P5_3	51	P5_3	P5_3	TAMPER1
M12	P5_4	-	-	P5_4	TAMPER2

Table 8. Tamper pins on MCXN23x*...continued*

184BGA ball	184VFBGA pin name	100HLQFP	100HLQFP pin name	ALT0	ALT3
K12	P5_5	-	-	P5_5	TAMPER3
K13	P5_6	-	-	P5_6	TAMPER4
L13	P5_7	-	-	P5_7	TAMPER5

6 Miscellaneous

This section provides details about the boot source and debugging.

6.1 Boot source

The MCXN23x does not have the FlexSPI module and does not support external flash boot, but the MCXNx4x supports external flash boot, which can be configured with the `BOOT_CFG` field in the Customer Manufacturing/ Factory Configuration Area (CMPA) to implement this function.

6.2 Debug

The MCXNx4x debug module supports ITM, DWT, ETM, ETB W/2KB RAM, and TPIU function, but the ETM and ETB W/2KB functions are removed on the MCXN23x.

6.3 Power management

Power management The power management of MCXN23x and MCXNx4x is identical, so they can use the same power supply circuit.

7 Software

This chapter describes some software considerations when porting the code from the MCXNx4x platform to the MCXN23x platform. In this section, take the `hello_world` project from the FRDM-MCXN236 SDK as an example, and the IDE is `IAR 9.40.1`.

7.1 Chip-specified header files

Each SDK project has a device directory containing chip-specific header files. These header files must be replaced when porting code between platforms, see Figure 11.

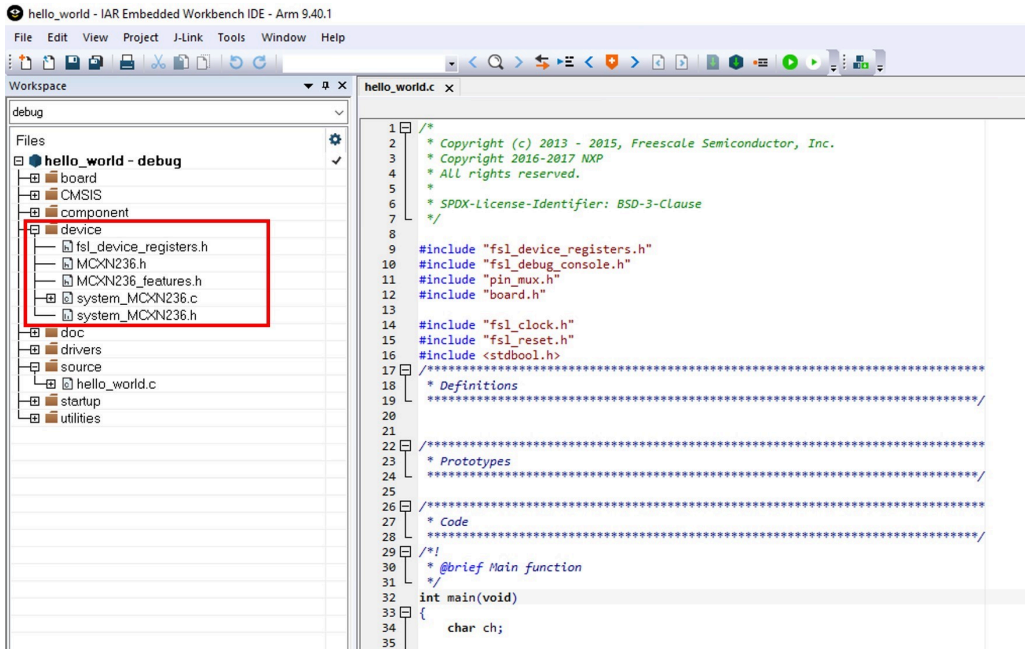


Figure 11. Chip-specified header files

7.2 SDK driver

Ensure that the SDK driver directory does not include unsupported modules such as FlexSPI and uSDHC for MCXN23x.

7.3 Start_up file

Replace the `start_up` file of MCXNx4x with MCXN23x `start_up` file, as some modules are removed, and the interrupt vector table is different.

7.4 Linker file

The MCXN23x and MCXNx4x can have different Flash and RAM sizes, so the customer must replace the linker file to ensure the Flash and RAM range used in the linker file is suitable.

7.5 IDE-related configuration update

When porting code from the MCXNx4x to MCXN23x, update IDE-related configurations such as path and macro definition, see Figure 12.

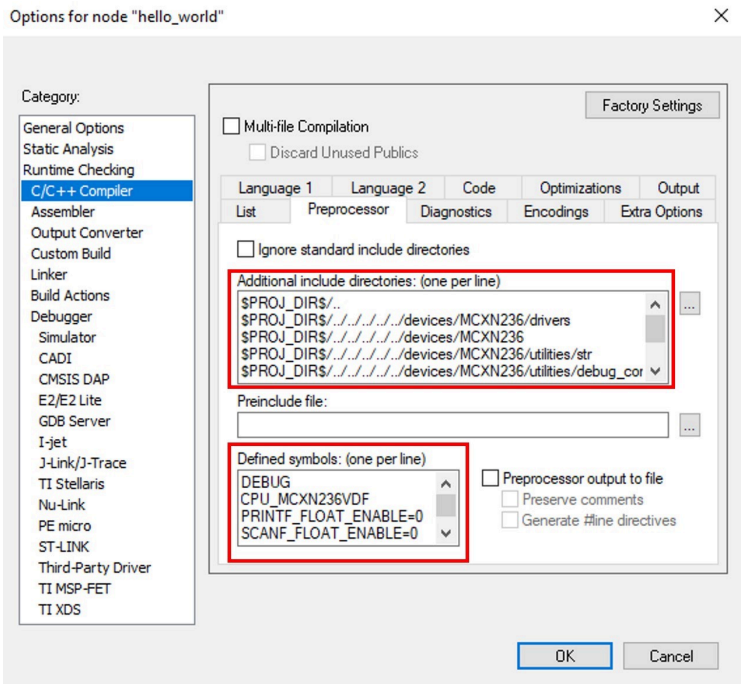


Figure 12. Path and macro definition

Note: *If the customer does not use the removed pins and peripherals on the MCXN23x, then the customer can directly solder the MCXN23x chip to the MCXNx4x board and can directly use the MCXNx4x software, but the linker file must be updated to match the flash and RAM size of MCXN23x. Currently, this method has only been verified on IAR IDE.*

8 Conclusion

This document compares system resources and software differences between the MCXNx4x and MCXN23x, making project migration quick and easy.

9 Related documentation/resources

Table 9 lists additional documents and resources that can be referred to for more information. Some of the documents listed below may be available only under a non-disclosure agreement (NDA). To request access to these documents, contact local field applications engineer (FAE) or sales representative.

Table 9. Related documentation/resources

Document	Link/how to access
MCX Nx4x Reference Manual (document MCXNX4XRM)	MCXNX4XRM
MCXN23x Reference Manual (document MCXN23XRM) (document MCXN23XRM)	MCXN23XRM

10 Acronyms and abbreviations

Table 10 defines the acronyms and abbreviations used in this document.

Table 10. Acronyms and abbreviations

Acronym	Definition
ADC	Analog-to-Digital Converter
CAN	Controller Area Network
CMP	Comparator
CMPA	Customer Manufacturing/Factory Configuration Area
CPU	Central Processing Unit
CRC	Cyclic Redundancy Check
DAC	Digital-to-Analog Converter
DMA	Direct Memory Access
DSP	Digital Signal Processor
DWT	Drop-Weight Tear
ECC	Error Correcting Code
eDMA	Enhanced Direct Memory Access
ETM	Embedded Trace Macrocell
ETB	Embedded Trace Buffer
FlexCAN	Flexible Controller Area Network Interface
FlexIO	Flexible Input/Output
GPIO	General-Purpose Input/Output
HS USB	High-Speed USB
I2C	Inter-Integrated Circuit
ITM	Instrumentation Trace Macrocell
IP	Internet Protocol
LDO	Liquid Crystal Display
LPC	Low Pin Count
MAC	Media Access Control
MCU	Microcontroller Unit
MII	Media-Independent Interface
NDA	Non-Disclosure Agreement
OS	Operating System
QDC	Quadrature Decoder
RTC	Real-Time Clock
TPIU	Trace Port Interface Unit
TSI	Touch System Interface
SAI	Serial Audio Interface
SDK	Software Development Kit
SPI	Serial Peripheral Interface
SRAM	Static Random-Access Memory

Table 10. Acronyms and abbreviations...*continued*

Acronym	Definition
RAM	Random-Access Memory
RMII	Reduced Media Independent Interface
TPIU	Trace Port Interface Unit
UART	Universal Asynchronous Receiver Transmitter
USB	Universal Serial Bus
VREF	Voltage Reference

11 Note about the source code in the document

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12 Revision history

Table 11 summarizes the revisions to this document.

Table 11. Revision history

Document ID	Release date	Description
AN14179 v.1.0	06 May 2024	Initial public version

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