

MPC7455 RISC Microprocessor Hardware Specifications Addendum for the XPC74n5RXnnnNx Series

This document describes part-number-specific changes to recommended operating conditions and revised electrical specifications, as applicable, from those described in the general *MPC7455 RISC Microprocessor Hardware Specifications* (Order No. MPC7455EC). The MPC7455 is a PowerPC™ microprocessor.

Specifications provided in this document supersede those in the *MPC7455 RISC Microprocessor Hardware Specifications*, Rev. 0 or later, for the part numbers listed in [Table A](#) only. Specifications not addressed herein are unchanged. Because this document is frequently updated, refer to <http://www.freescale.com> or contact your Freescale sales office for the latest version.

Note that headings and table numbers in this document are not consecutively numbered. They are intended to correspond to the heading or table affected in the general hardware specification.

Freescale Part Numbers Affected:

XPC7455RX600NC
XPC7455RX733NC
XPC7455RX800NC
XPC7445RX600NC
XPC7445RX733NC
XPC7445RX800NC

Part numbers addressed in this document are listed in [Table A](#).

Table A. Part Numbers Addressed by This Data Sheet

Freescale Part Number	Operating Conditions			Significant Differences from Hardware Specification
	CPU Frequency (MHz)	V _{DD}	T _j (°C)	
XPC7455RX600NC	600	1.3 V ± 50 mV	0 to 105	Modified core and VCO frequency, and power consumption specifications
XPC7455RX733NC	733			
XPC7455RX800NC	800			
XPC7445RX600NC	600			
XPC7445RX733NC	733			
XPC7445RX800NC	800			

Note: The X prefix in a Freescale part number designates a “Pilot Production Prototype” as defined by Freescale SOP 3-13. These are from a limited production volume of prototypes manufactured, tested, and Q.A. inspected on a qualified technology to simulate normal production. These parts have only preliminary reliability and characterization data. Before pilot production prototypes may be shipped, written authorization from the customer must be on file in the applicable sales office acknowledging the qualification status and the fact that product changes may still occur while shipping pilot production prototypes.

1.1 Features

This section summarizes changes to the features of the MPC7455 described in the *MPC7455 RISC Microprocessor Hardware Specifications*.

- Power management
 - 1.3-V processor core

1.3 General Parameters

- Core power supply: 1.3 V ± 50 mV DC nominal

1.5.1 DC Electrical Characteristics

[Table 4](#) provides the recommended operating conditions for the MPC7455 part numbers described herein.

Table 4. Recommended Operating Conditions

Characteristic	Symbol	Recommended Value	Unit
Core supply voltage	V _{DD}	1.3 V ± 50 mV	V
PLL supply voltage	AV _{DD}	1.3 V ± 50 mV	V

Note: These are the recommended and tested operating conditions. Proper device operation outside of these conditions is not guaranteed.

Table 7 provides the power consumption for the MPC7455 part numbers described herein.

Table 7. Power Consumption for MPC7455

	Processor (CPU) Frequency			Unit	Notes
	600 MHz	733 MHz	800 MHz		
Full-Power Mode					
Typical	8.4	10.3	11.2	W	1, 3
Maximum	11.9	14.5	15.9	W	1, 2
Doze Mode					
Typical	—	—	—	W	1, 2, 4
Nap Mode					
Typical	1.4	1.7	1.8	W	1, 2
Sleep Mode					
Typical	700	800	900	mW	1, 2
Deep Sleep Mode (PLL Disabled)					
Typical	470	490	500	mW	1, 3

Notes:

1. These values apply for all valid processor bus and L3 bus ratios. The values do not include I/O supply power (OV_{DD} and GV_{DD}) or PLL supply power (AV_{DD}). OV_{DD} and GV_{DD} power is system dependent, but is typically < 5% of V_{DD} power. Worst case power consumption for $AV_{DD} < 3$ mW.
2. Maximum power is measured at nominal V_{DD} while running an entirely cache-resident, contrived sequence of instructions which keep the execution units, with or without Altivec™, maximally busy.
3. Typical power is an average value measured at nominal V_{DD} in a system while running a typical code sequence.
4. Doze mode is not a user-definable state; it is an intermediate state between full-power and either nap or sleep mode. As a result, power consumption for this mode is not tested.

Table 8 provides the clock AC timing specifications for the MPC7455 part numbers described herein.

Table 8. Clock AC Timing Specifications

At recommended operating conditions. See Table 4.

Characteristic	Symbol	Maximum Processor Core Frequency						Unit	Notes
		600 MHz		733 MHz		800 MHz			
		Min	Max	Min	Max	Min	Max		
Processor frequency	f_{core}	500	600	500	733	500	800	MHz	1
VCO frequency	f_{VCO}	1000	1200	1000	1466	1000	1600	MHz	1

Note:

- Caution:** The SYSCLK frequency, PLL_CFG[0:4] settings must be chosen such that the resulting SYSCLK (bus) frequency, CPU (core) frequency, and PLL (VCO) frequency do not exceed their respective maximum or minimum operating frequencies (see Table 4 in the *MPC7455 RISC Microprocessor Hardware Specifications*). Refer to the PLL_CFG[0:4] signal description in Section 1.9.1, “PLL Configuration,” for valid PLL_CFG[0:4] settings.

Table 12 provides the L3 bus interface AC timing specifications for MSUG2 for the MPC7455 part numbers described herein.

Table 12. L3 Bus Interface AC Timing Specifications for MSUG2

At recommended operating conditions. See Table 4.

Parameter	Symbol	All Speed Grades				Unit	Notes
		L2CR[12] = 0 and L3CR[12] = 0 ⁸		L2CR[12] = 1 and L3CR[12] = 1 ⁸			
		Min	Max	Min	Max		
L3_CLK rise and fall time	t_{L3CR} , t_{L3CF}	—	1.0	—	1.0	ns	1
Setup times: Data and parity	t_{L3DVEH} , t_{L3DVEL}	-0.1	—	-0.1	—	ns	2, 3, 4
Input hold times: Data and parity	t_{L3DXEH} , t_{L3DXEL}	$t_{\text{L3_ECHO_CLK}}/4$ + 0.6	—	$t_{\text{L3_ECHO_CLK}}/4$ + 0.6	—	ns	2, 4
Valid times: Data and parity	t_{L3CHDV} , t_{L3CLDV}	—	$(-t_{\text{L3_CLK}}/4)$ + 0.4	—	$(-t_{\text{L3_CLK}}/4)$ + 0.8	ns	5, 6, 7
Valid times: All other outputs	t_{L3CHOV}	—	$t_{\text{L3_CLK}}/4$ + 1.0	—	$t_{\text{L3_CLK}}/4$ + 1.2	ns	5, 7
Output hold times: Data and parity	t_{L3CHDX} , t_{L3CLDX}	$t_{\text{L3_CLK}}/4$ - 0.4	—	$t_{\text{L3_CLK}}/4$ - 0.2	—	ns	5, 6, 7
Output hold times: All other outputs	t_{L3CHOX}	$t_{\text{L3_CLK}}/4$ - 0.5	—	$t_{\text{L3_CLK}}/4$ - 0.3	—	ns	5, 7
L3_CLK to high impedance: Data and parity	t_{L3CLDZ}	—	$t_{\text{L3_CLK}}/2$	—	$t_{\text{L3_CLK}}/2$	ns	

Table 12. L3 Bus Interface AC Timing Specifications for MSUG2 (continued)

At recommended operating conditions. See Table 4.

Parameter	Symbol	All Speed Grades				Unit	Notes
		L2CR[12] = 0 and L3CR[12] = 0 ⁸		L2CR[12] = 1 and L3CR[12] = 1 ⁸			
		Min	Max	Min	Max		
L3_CLK to high impedance: All other outputs	t _{L3CHOZ}	—	t _{L3_CLK} /4 + 2.0	—	t _{L3_CLK} /4 + 2.0	ns	

Notes:

1. Rise and fall times for the L3_CLK output are measured from 20% to 80% of GV_{DD}.
2. For DDR, all input specifications are measured from the midpoint of the signal in question to the midpoint voltage of the rising or falling edge of the input L3_ECHO_CLK_n (see Figure 10 in the *MPC7455 RISC Microprocessor Hardware Specifications*). Input timings are measured at the pins.
3. For DDR, the input data will typically follow the edge of L3_ECHO_CLK_n as shown in Figure 10 in the *MPC7455 RISC Microprocessor Hardware Specifications*. For consistency with other input setup time specifications, this will be treated as negative input setup time.
4. t_{L3_ECHO_CLK}/4 is one-fourth the period of L3_ECHO_CLK_n. This parameter indicates that the MPC7455 can latch an input signal that is valid for only a short time before and a short time after the midpoint between the rising and falling (or falling and rising) edges of L3_ECHO_CLK_n at any frequency.
5. All output specifications are measured from the midpoint voltage of the rising (or for DDR write data, also the falling) edge of L3_CLK to the midpoint of the signal in question. The output timings are measured at the pins. All output timings assume a purely resistive 50-Ω load (see Figure 8 in the *MPC7455 RISC Microprocessor Hardware Specifications*).
6. For DDR, the output data will typically lead the edge of L3_CLK_n as shown in Figure 10 in the *MPC7455 RISC Microprocessor Hardware Specifications*. For consistency with other output valid time specifications, this will be treated as negative output valid time.
7. t_{L3_CLK}/4 is one-fourth the period of L3_CLK_n. This parameter indicates that the specified output signal is actually launched by an internal clock delayed in phase by 90°. Therefore, there is a frequency component to the output valid and output hold times such that the specified output signal will be valid for approximately one L3_CLK period starting three-fourths of a clock prior to the edge on which the SRAM will sample it and ending one-fourth of a clock period after the edge it will be sampled.
8. These configuration bits allow the AC timing of the L3 interface to be altered via software. They must be both set or both cleared; other configurations will increase t_{L3CSKW1}, which may cause unreliable L3 operation.

Table 13 provides the L3 bus AC timing specifications for PB2 and Late Write SRAMs for the MPC7455 part numbers described herein.

Table 13. L3 Bus Interface AC Timing Specifications for PB2 and Late Write SRAMs

At recommended operating conditions. See Table 4.

Parameter	Symbol	All Speed Grades				Unit	Notes
		L2CR[12]=0 and L3CR[12]=0 ⁶		L2CR[12]=1 and L3CR[12]=1 ⁶			
		Min	Max	Min	Max		
L3_CLK rise and fall time	t_{L3CR} , t_{L3CF}	—	1.0	—	1.0	ns	1, 5
Setup times: Data and parity	t_{L3DVEH}	1.5	—	1.5	—	ns	2, 5
Input hold times: Data and parity	t_{L3DXEH}	—	0.5	—	0.5	ns	2, 5
Valid times: Data and parity	t_{L3CHDV}	—	$t_{L3_CLK}/4 + 1.0$	—	$t_{L3_CLK}/4 + 1.2$	ns	3, 4, 5
Valid times: All other outputs	t_{L3CHOV}	—	$t_{L3_CLK}/4 + 1.0$	—	$t_{L3_CLK}/4 + 1.2$	ns	4
Output hold times: Data and parity	t_{L3CHDX}	$t_{L3_CLK}/4 - 0.4$	—	$t_{L3_CLK}/4 - 0.2$	—	ns	3, 4, 5
Output hold times: All other outputs	t_{L3CHOX}	$t_{L3_CLK}/4 - 0.4$	—	$t_{L3_CLK}/4 - 0.2$	—	ns	4, 5
L3_CLK to high impedance: Data and parity	t_{L3CHDZ}	—	2.0	—	2.0	ns	5
L3_CLK to high impedance: All other outputs	t_{L3CHOZ}	—	2.0	—	2.0	ns	5

Notes:

1. Rise and fall times for the L3_CLK output are measured from 20% to 80% of GV_{DD} .
2. All input specifications are measured from the midpoint of the signal in question to the midpoint voltage of the rising edge of the input L3_ECHO_CLK n (see Figure 10 in the *MPC7455 RISC Microprocessor Hardware Specifications*). Input timings are measured at the pins.
3. All output specifications are measured from the midpoint voltage of the rising edge of L3_CLK n to the midpoint of the signal in question. The output timings are measured at the pins. All output timings assume a purely resistive 50- Ω load (see Figure 10 in the *MPC7455 RISC Microprocessor Hardware Specifications*).
4. $t_{L3_CLK}/4$ is one-fourth the period of L3_CLK n . This parameter indicates that the specified output signal is actually launched by an internal clock delayed in phase by 90°. Therefore, there is a frequency component to the output valid and output hold times such that the specified output signal will be valid for approximately one L3_CLK period starting three-fourths of a clock prior to the edge on which the SRAM will sample it and ending one-fourth of a clock period after the edge it will be sampled.
5. Timing behavior and characterization are currently being evaluated.
6. These configuration bits allow the AC timing of the L3 interface to be altered via software. They must be both set or both cleared; other configurations will increase $t_{L3CSKW1}$ and $t_{L3CSKW2}$, which may cause unreliable L3 operation.

1.9.1 PLL Configuration

The MPC7455 PLL is configured by the PLL_CFG[0:4] signals; note that PLL_CFG[4] was formerly called PLL_EXT in earlier documentation. For a given SYSCLK (bus) frequency, the PLL configuration signals set the internal CPU and VCO frequency of operation. PLL_CFG[4] will normally be pulled low but can be asserted for extended modes of operation. The PLL configuration for the MPC7455 is shown in Table 17 for a set of example frequencies. In this example, shaded cells represent settings that, for a given SYSCLK frequency, result in core and/or VCO frequencies that do not comply with the 1-GHz column in Table 8. Note that the settings for Rev. C devices are different than those for subsequent devices.

Table 17. MPC7455 Microprocessor PLL Configuration Example for 800-MHz Parts

PLL_CFG [0:4]	Example Bus-to-Core Frequency in MHz (VCO Frequency in MHz)								
	Bus-to- Core Multiplier	Core-to- VCO Multiplier	Bus 33.3 MHz	Bus 50 MHz	Bus 66.6 MHz	Bus 75 MHz	Bus 83 MHz	Bus 100 MHz	Bus 133 MHz
00000	0.5x	2x							
01000	2x	2x							
01100	2.5x	2x							
10000	3x	2x							
11100	3.5x	2x							
10100	4x	2x							533 (1066)
01110	4.5x	2x							600 (1200)
10110	5x	2x						500 (1000)	667 (1333)
10010	5.5x	2x						550 (1100)	733 (1466)
11010	6x	2x						600 (1200)	800 (1600)
01010	6.5x	2x					540 (1080)	650 (1300)	
00100	7x	2x				525 (1050)	580 (1160)	700 (1400)	
00010	7.5x	2x			500 (1000)	563 (1125)	623 (1245)	750 (1500)	
11000	8x	2x			533 (1066)	600 (1200)	664 (1328)	800 (1600)	

Table 17. MPC7455 Microprocessor PLL Configuration Example for 800-MHz Parts (continued)

PLL_CFG [0:4]	Example Bus-to-Core Frequency in MHz (VCO Frequency in MHz)								
	Bus-to-Core Multiplier	Core-to-VCO Multiplier	Bus 33.3 MHz	Bus 50 MHz	Bus 66.6 MHz	Bus 75 MHz	Bus 83 MHz	Bus 100 MHz	Bus 133 MHz
01111	9x	2x			600 (1200)	675 (1350)	747 (1494)		
10101	10x	2x		500 (1000)	667 (1333)	750 (1500)			
10011	11x	2x		550 (1100)	733 (1466)				
10111	12x	2x		600 (1200)	800 (1600)				
01011	13x	2x		650 (1300)					
11001	14x	2x		700 (1400)					
00011	15x	2x	500 (1000)	750 (1500)					
11011	16x	2x	533 (1066)	800 (1600)					
00110	PLL off/bypass		PLL off, SYSCCLK clocks core circuitry directly						
11110	PLL off		PLL off, no core clocking occurs						

11.1 Ordering Information

1.11.1 Part Numbers Addressed by This Specification

Table 21 provides the ordering information for the MPC7455 parts described in this document.

Table 21. Part Marking Nomenclature

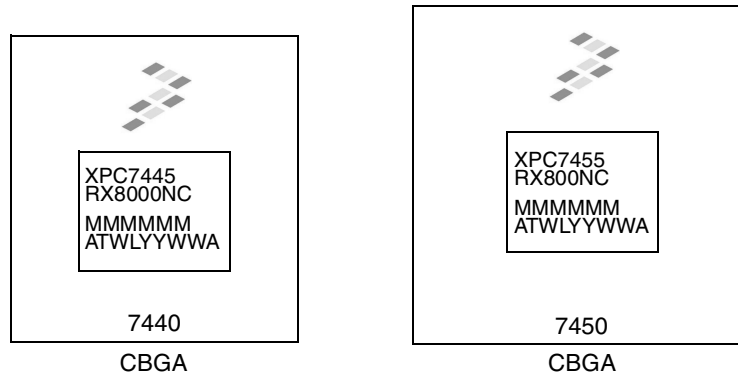
XPC	74n5	RX	nnn	x	x
Product Code	Part Identifier	Package	Processor Frequency ¹	Application Modifier	Revision Level
XPC ²	7455 7445	RX = CBGA	600 733 800	N: 1.3 V ± 50 mV 0 to 105°C	C: 2.1; PVR = 8001 0201

Notes:

1. Processor core frequencies supported by parts addressed by this specification only. Parts addressed by other specifications may support other maximum core frequencies.
2. The X prefix in a Freescale part number designates a “Pilot Production Prototype” as defined by Freescale SOP 3-13. These are from a limited production volume of prototypes manufactured, tested, and Q.A. inspected on a qualified technology to simulate normal production. These parts have only preliminary reliability and characterization data. Before pilot production prototypes may be shipped, written authorization from the customer must be on file in the applicable sales office acknowledging the qualification status and the fact that product changes may still occur while shipping pilot production prototypes.

1.11.3 Part Marking

Parts are marked as the example shown in Figure 29.



Notes:

- MMMMMM is the 6-digit mask number.
- ATWLYYWWA is the traceability code.
- CCCCC is the country of assembly. This space is left blank if parts are assembled in the United States.

Figure 29. Freescale Part Marking for CBGA Device

Document Revision History

Table B provides a revision history for this part number specification.

Table B. Document Revision History

Rev. No.	Substantive Change(s)
0	Initial release.
0.1	Updated wording in Table A, "Significant Differences from Hardware Specification," column.
	Corrected part number in heading of Table 7 (changed from MPC7450 to MPC7455).
	Added Document Revision History section and Table B.
1	Updated Table 7, note 1.
	Added Tables 2, 12, 13, and 17.
1.1	Table 9: corrected typo in units for Sleep Mode power, changed 'W' to 'mW.'
	Table 17: corrected PLL_CFG values; previous revisions of this specification had swapped PLL_CFG[0] with PLL_CFG[4].
1.2	Changed document order number (was MPC7455RXNXPNS, Rev. 1.1). Updated to Freescale template.

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