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Understanding Embedded - Microprocessors

Embedded microprocessors are specialized computing chips designed to perform specific tasks within an embedded system. Unlike general-purpose microprocessors found in personal computers, embedded microprocessors are tailored for dedicated functions within larger systems, offering optimized performance, efficiency, and reliability. These microprocessors are integral to the operation of countless electronic devices, providing the computational power necessary for controlling processes, handling data, and managing communications.

Applications of Embedded - Microprocessors

Embedded microprocessors are utilized across a broad spectrum of applications, making them indispensable in

Details	
Product Status	Obsolete
Core Processor	PowerPC
Number of Cores/Bus Width	1 Core, 32-Bit
Speed	400MHz
Co-Processors/DSP	-
RAM Controllers	-
Graphics Acceleration	No
Display & Interface Controllers	-
Ethernet	-
SATA	-
USB	-
Voltage - I/O	2.5V, 3.3V
Operating Temperature	0°C ~ 105°C (TA)
Security Features	-
Package / Case	360-BCBGA, FCCBGA
Supplier Device Package	360-CBGA (25x25)
Purchase URL	https://www.e-xfl.com/product-detail/nxp-semiconductors/mpc755crx400le

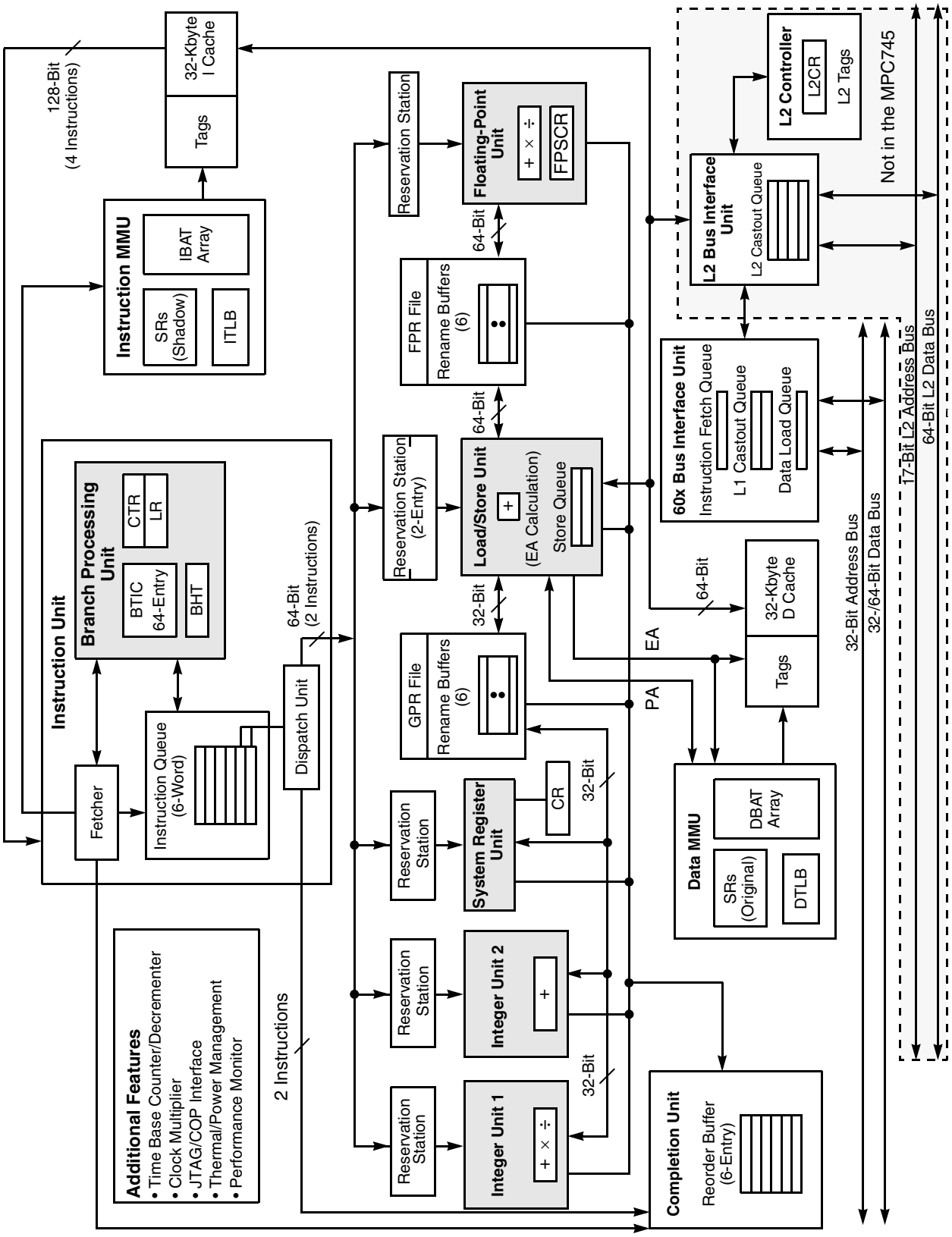


Figure 1. MPC755 Block Diagram

Packages	MPC745: Surface mount 255 plastic ball grid array (PBGA) MPC755: Surface mount 360 ceramic ball grid array (CBGA) Surface mount 360 plastic ball grid array (PBGA)
Core power supply	2.0 V ± 100 mV DC (nominal; some parts support core voltages down to 1.8 V; see Table 3 for recommended operating conditions)
I/O power supply	2.5 V ± 100 mV DC or 3.3 V ± 165 mV DC (input thresholds are configuration pin selectable)

4 Electrical and Thermal Characteristics

This section provides the AC and DC electrical specifications and thermal characteristics for the MPC755.

4.1 DC Electrical Characteristics

Table 1 through Table 7 describe the MPC755 DC electrical characteristics. Table 1 provides the absolute maximum ratings.

Table 1. Absolute Maximum Ratings[1]

Characteristic		Symbol	Maximum Value	Unit	Notes
Core supply voltage		V_{DD}	–0.3 to 2.5	V	4
PLL supply voltage		AV_{DD}	–0.3 to 2.5	V	4
L2 DLL supply voltage		$L2AV_{DD}$	–0.3 to 2.5	V	4
Processor bus supply voltage		OV_{DD}	–0.3 to 3.6	V	3
L2 bus supply voltage		$L2OV_{DD}$	–0.3 to 3.6	V	3
Input voltage	Processor bus	V_{in}	–0.3 to OV_{DD} + 0.3 V	V	2, 5
	L2 bus	V_{in}	–0.3 to $L2OV_{DD}$ + 0.3 V	V	2, 5
	JTAG signals	V_{in}	–0.3 to 3.6	V	
Storage temperature range		T_{stg}	–55 to 150	°C	

Notes:

1. Functional and tested operating conditions are given in Table 3. Absolute maximum ratings are stress ratings only, and functional operation at the maximums is not guaranteed. Stresses beyond those listed may affect device reliability or cause permanent damage to the device.
2. **Caution:** V_{in} must not exceed OV_{DD} or $L2OV_{DD}$ by more than 0.3 V at any time including during power-on reset.
3. **Caution:** $L2OV_{DD}/OV_{DD}$ must not exceed $V_{DD}/AV_{DD}/L2AV_{DD}$ by more than 1.6 V during normal operation. During power-on reset and power-down sequences, $L2OV_{DD}/OV_{DD}$ may exceed $V_{DD}/AV_{DD}/L2AV_{DD}$ by up to 3.3 V for up to 20 ms, or by 2.5 V for up to 40 ms. Excursions beyond 3.3 V or 40 ms are not supported.
4. **Caution:** $V_{DD}/AV_{DD}/L2AV_{DD}$ must not exceed $L2OV_{DD}/OV_{DD}$ by more than 0.4 V during normal operation. During power-on reset and power-down sequences, $V_{DD}/AV_{DD}/L2AV_{DD}$ may exceed $L2OV_{DD}/OV_{DD}$ by up to 1.0 V for up to 20 ms, or by 0.7 V for up to 40 ms. Excursions beyond 1.0 V or 40 ms are not supported.
5. This is a DC specifications only. V_{in} may overshoot/undershoot to a voltage and for a maximum duration as shown in Figure 2.

4.2 AC Electrical Characteristics

This section provides the AC electrical characteristics for the MPC755. After fabrication, functional parts are sorted by maximum processor core frequency as shown in Section 4.2.1, "Clock AC Specifications," and tested for conformance to the AC specifications for that frequency. The processor core frequency is determined by the bus (SYSCLK) frequency and the settings of the PLL_CFG[0:3] signals. Parts are sold by maximum processor core frequency; see Section 10, "Ordering Information."

4.2.1 Clock AC Specifications

Table 8 provides the clock AC timing specifications as defined in Figure 3.

Table 8. Clock AC Timing Specifications

At recommended operating conditions (see Table 3)

Characteristic	Symbol	Maximum Processor Core Frequency						Unit	Notes
		300 MHz		350 MHz		400 MHz			
		Min	Max	Min	Max	Min	Max		
Processor frequency	f_{core}	200	300	200	350	200	400	MHz	1
VCO frequency	f_{VCO}	400	600	400	700	400	800	MHz	1
SYSCLK frequency	f_{SYSCLK}	25	100	25	100	25	100	MHz	1
SYSCLK cycle time	t_{SYSCLK}	10	40	10	40	10	40	ns	
SYSCLK rise and fall time	t_{KR}, t_{KF}	—	2.0	—	2.0	—	2.0	ns	2
	t_{KR}, t_{KF}	—	1.4	—	1.4	—	1.4	ns	2
SYSCLK duty cycle measured at $OV_{DD}/2$	t_{KHKL}/t_{SYSCLK}	40	60	40	60	40	60	%	3
SYSCLK jitter		—	±150	—	±150	—	±150	ps	3, 4
Internal PLL relock time		—	100	—	100	—	100	μs	3, 5

Notes:

1. **Caution:** The SYSCLK frequency and PLL_CFG[0:3] 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. Refer to the PLL_CFG[0:3] signal description in Section 8.1, "PLL Configuration," for valid PLL_CFG[0:3] settings.
2. Rise and fall times measurements are now specified in terms of slew rates, rather than time to account for selectable I/O bus interface levels. The minimum slew rate of 1 V/ns is equivalent to a 2 ns maximum rise/fall time measured at 0.4 and 2.4 V (OV_{DD} = 3.3 V) or a rise/fall time of 1 ns measured at 0.4 and 1.8 V (OV_{DD} = 2.5 V).
3. Timing is guaranteed by design and characterization.
4. This represents total input jitter—short term and long term combined—and is guaranteed by design.
5. Relock timing is guaranteed by design and characterization. PLL-relock time is the maximum amount of time required for PLL lock after a stable V_{DD} and SYSCLK are reached during the power-on reset sequence. This specification also applies when the PLL has been disabled and subsequently re-enabled during sleep mode. Also note that $\overline{\text{HRESET}}$ must be held asserted for a minimum of 255 bus clocks after the PLL-relock time during the power-on reset sequence.

Figure 3 provides the SYSCLK input timing diagram.

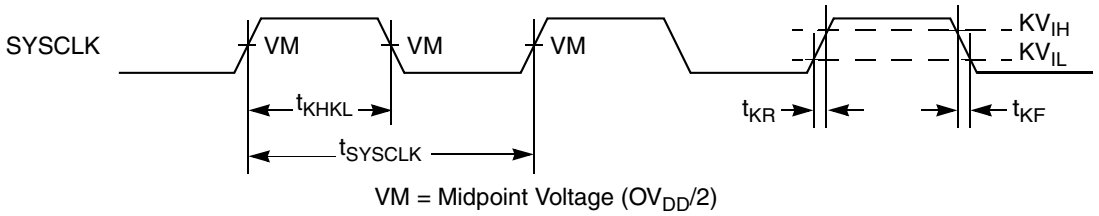


Figure 3. SYSCLK Input Timing Diagram

4.2.2 Processor Bus AC Specifications

Table 9 provides the processor bus AC timing specifications for the MPC755 as defined in Figure 4 and Figure 6. Timing specifications for the L2 bus are provided in Section 4.2.3, "L2 Clock AC Specifications."

Table 9. Processor Bus Mode Selection AC Timing Specifications [1]

At recommended operating conditions (see Table 3)

Parameter	Symbol [2]	All Speed Grades		Unit	Notes
		Min	Max		
Mode select input setup to $\overline{\text{HRESET}}$	t_{MVRH}	8	—	t_{sysclk}	3, 4, 5, 6, 7
$\overline{\text{HRESET}}$ to mode select input hold	t_{MXRH}	0	—	ns	3, 4, 6, 7, 8

Notes:

1. All input specifications are measured from the midpoint of the signal in question to the midpoint of the rising edge of the input SYSCLK. All output specifications are measured from the midpoint of the rising edge of SYSCLK to the midpoint of the signal in question. All output timings assume a purely resistive 50-Ω load (see Figure 5). Input and output timings are measured at the pin; time-of-flight delays must be added for trace lengths, vias, and connectors in the system.
2. The symbology used for timing specifications herein follows the pattern of $t_{\text{(signal)(state)(reference)(state)}}$ for inputs and $t_{\text{(reference)(state)(signal)(state)}}$ for outputs. For example, t_{IVKH} symbolizes the time input signals (I) reach the valid state (V) relative to the SYSCLK reference (K) going to the high (H) state or input setup time. And t_{KHOV} symbolizes the time from SYSCLK (K) going high (H) until outputs (O) are valid (V) or output valid time. Input hold time can be read as the time that the input signal (I) went invalid (X) with respect to the rising clock edge (KH)—note the position of the reference and its state for inputs—and output hold time can be read as the time from the rising edge (KH) until the output went invalid (OX).
3. The setup and hold time is with respect to the rising edge of $\overline{\text{HRESET}}$ (see Figure 4).
4. This specification is for configuration mode select only. Also note that the $\overline{\text{HRESET}}$ must be held asserted for a minimum of 255 bus clocks after the PLL-relock time during the power-on reset sequence.
5. t_{sysclk} is the period of the external clock (SYSCLK) in ns. The numbers given in the table must be multiplied by the period of SYSCLK to compute the actual time duration (in ns) of the parameter in question.
6. Mode select signals are BVSEL, L2VSEL, PLL_CFG[0:3], and $\overline{\text{TLBISYNC}}$.
7. Guaranteed by design and characterization.
8. Bus mode select pins must remain stable during operation. Changing the logic states of BVSEL or L2VSEL during operation will cause the bus mode voltage selection to change. Changing the logic states of the PLL_CFG pins during operation will cause the PLL division ratio selection to change. Both of these conditions are considered outside the specification and are not supported. Once $\overline{\text{HRESET}}$ is negated the states of the bus mode selection pins must remain stable.

Figure 4 provides the mode select input timing diagram for the MPC755.

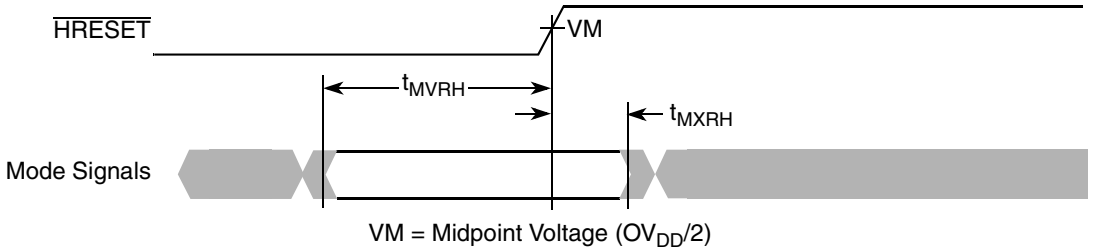


Figure 4. Mode Input Timing Diagram

Figure 5 provides the AC test load for the MPC755.

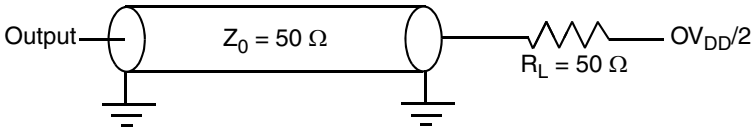


Figure 5. AC Test Load

Table 10. Processor Bus AC Timing Specifications [1]

At recommended operating conditions (see Table 3)

Parameter	Symbol	All Speed Grades		Unit	Notes
		Min	Max		
Setup times: All inputs	t_{IVKH}	2.5	—	ns	
Input hold times: $\overline{\text{TLBISYNC}}$, $\overline{\text{MCP}}$, $\overline{\text{SMI}}$	t_{IXKH}	0.6	—	ns	6
Input hold times: All inputs, except $\overline{\text{TLBISYNC}}$, $\overline{\text{MCP}}$, $\overline{\text{SMI}}$	t_{IXKH}	0.2	—	ns	6
Valid times: All outputs	t_{KHOV}	—	4.1	ns	
Output hold times: All outputs	t_{KHOX}	1.0	—	ns	
SYSCLK to output enable	t_{KHOE}	0.5	—	ns	2
SYSCLK to output high impedance (all except $\overline{\text{ABB}}$, $\overline{\text{ARTRY}}$, $\overline{\text{DBB}}$)	t_{KHOZ}	—	6.0	ns	2
SYSCLK to $\overline{\text{ABB}}$, $\overline{\text{DBB}}$ high impedance after precharge	t_{KHABPZ}	—	1.0	t_{sysclk}	2, 3, 4
Maximum delay to $\overline{\text{ARTRY}}$ precharge	t_{KHARP}	—	1	t_{sysclk}	2, 3, 5
SYSCLK to $\overline{\text{ARTRY}}$ high impedance after precharge	t_{KHARPZ}	—	2	t_{sysclk}	2, 3, 5

Notes:

1. Revisions prior to Rev. 2.8 (Rev. E) were limited in performance and did not conform to this specification. For more information, refer to Section 10.2, "Part Numbers Not Fully Addressed by This Document."
2. Guaranteed by design and characterization.
3. t_{sysclk} is the period of the external clock (SYSCLK) in ns. The numbers given in the table must be multiplied by the period of SYSCLK to compute the actual time duration (in ns) of the parameter in question.
4. Per the 60x bus protocol, $\overline{\text{TS}}$, $\overline{\text{ABB}}$, and $\overline{\text{DBB}}$ are driven only by the currently active bus master. They are asserted low, then precharged high before returning to high-Z as shown in Figure 6. The nominal precharge width for $\overline{\text{TS}}$, $\overline{\text{ABB}}$, or $\overline{\text{DBB}}$ is $0.5 \times t_{sysclk}$, that is, less than the minimum t_{sysclk} period, to ensure that another master asserting $\overline{\text{TS}}$, $\overline{\text{ABB}}$, or $\overline{\text{DBB}}$ on the following clock will not contend with the precharge. Output valid and output hold timing is tested for the signal asserted. Output valid time is tested for precharge. The high-Z behavior is guaranteed by design.
5. Per the 60x bus protocol, $\overline{\text{ARTRY}}$ can be driven by multiple bus masters through the clock period immediately following $\overline{\text{AACK}}$. Bus contention is not an issue since any master asserting $\overline{\text{ARTRY}}$ will be driving it low. Any master asserting it low in the first clock following $\overline{\text{AACK}}$ will then go to high-Z for one clock before precharging it high during the second cycle after the assertion of $\overline{\text{AACK}}$. The nominal precharge width for $\overline{\text{ARTRY}}$ is 1.0 t_{sysclk}; that is, it should be high-Z as shown in Figure 6 before the first opportunity for another master to assert $\overline{\text{ARTRY}}$. Output valid and output hold timing is tested for the signal asserted. Output valid time is tested for precharge. The high-Z and precharge behavior is guaranteed by design.
6. $\overline{\text{MCP}}$ and $\overline{\text{SRESET}}$ must be held asserted for a minimum of two bus clock cycles; $\overline{\text{INT}}$ and $\overline{\text{SMI}}$ should be held asserted until the exception is taken; $\overline{\text{CKSTP\_IN}}$ must be held asserted until the system has been reset. See the *MPC750 RISC Microprocessor Family User's Manual* for more information.

Figure 6 provides the input/output timing diagram for the MPC755.

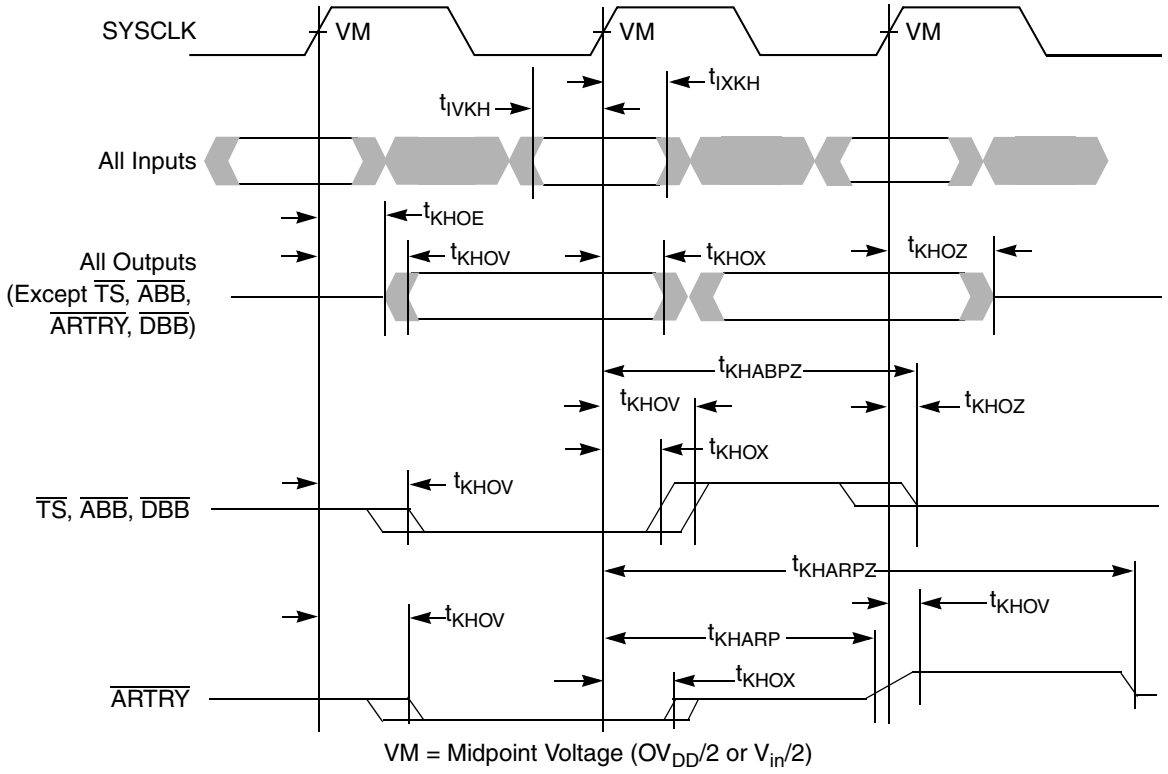


Figure 6. Input/Output Timing Diagram

4.2.3 L2 Clock AC Specifications

The L2CLK frequency is programmed by the L2 configuration register (L2CR[4–6]) core-to-L2 divisor ratio. See Table 17 for example core and L2 frequencies at various divisors. Table 11 provides the potential range of L2CLK output AC timing specifications as defined in Figure 7.

The minimum L2CLK frequency of Table 11 is specified by the maximum delay of the internal DLL. The variable-tap DLL introduces up to a full clock period delay in the L2CLK_OUTA, L2CLK_OUTB, and L2SYNC_OUT signals so that the returning L2SYNC_IN signal is phase-aligned with the next core clock (divided by the L2 divisor ratio). Do not choose a core-to-L2 divisor which results in an L2 frequency below this minimum, or the L2CLK_OUT signals provided for SRAM clocking will not be phase-aligned with the MPC755 core clock at the SRAMs.

The maximum L2CLK frequency shown in Table 11 is the core frequency divided by one. Very few L2 SRAM designs will be able to operate in this mode, especially at higher core frequencies. Therefore, most designs will select a greater core-to-L2 divisor to provide a longer L2CLK period for read and write access to the L2 SRAMs. The maximum L2CLK frequency for any application of the MPC755 will be a function of the AC timings of the MPC755, the AC timings for the SRAM, bus loading, and printed-circuit board trace length. The current AC timing of the MPC755 supports up to 200 MHz with typical, similarly-rated SRAM parts, provided careful design practices are observed. Clock trace lengths must be matched and all trace lengths should be as short as possible. Higher frequencies can be achieved by using better performing

The L2CLK_OUT timing diagram is shown in Figure 7.

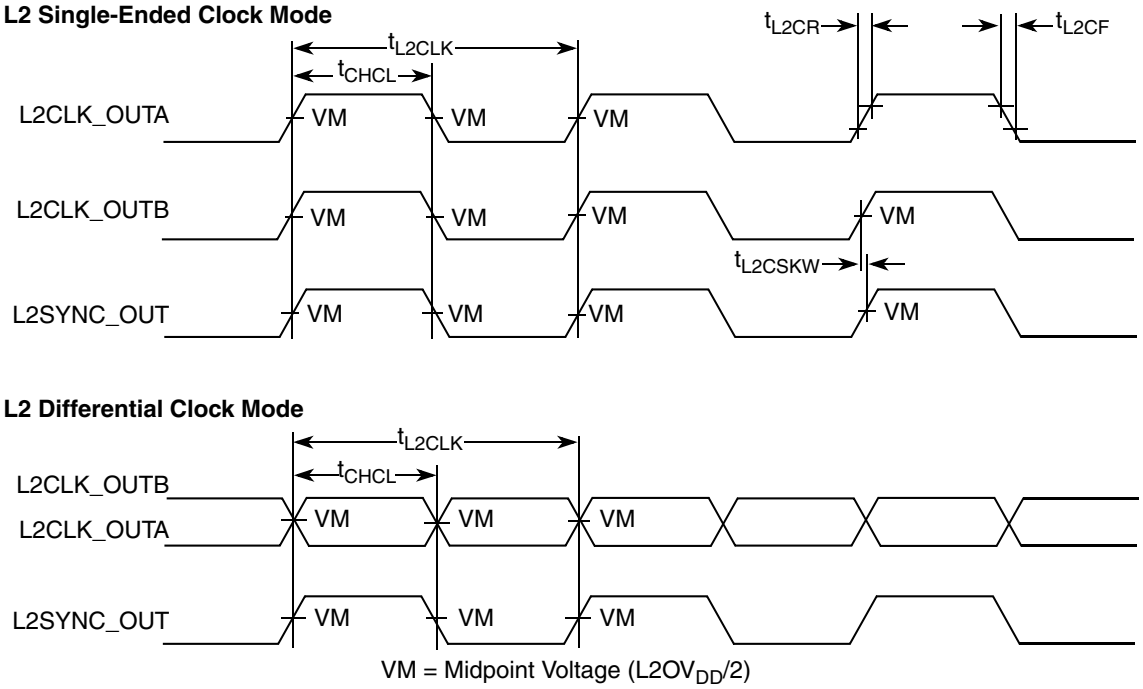


Figure 7. L2CLK_OUT Output Timing Diagram

4.2.4 L2 Bus AC Specifications

Table 12 provides the L2 bus interface AC timing specifications for the MPC755 as defined in Figure 8 and Figure 9 for the loading conditions described in Figure 10.

Table 12. L2 Bus Interface AC Timing Specifications

At recommended operating conditions (see Table 3)

Parameter	Symbol	All Speed Grades		Unit	Notes
		Min	Max		
L2SYNC_IN rise and fall time	t_{L2CR}, t_{L2CF}	—	1.0	ns	1
Setup times: Data and parity	t_{DVL2CH}	1.2	—	ns	2
Input hold times: Data and parity	t_{DXL2CH}	0	—	ns	2
Valid times: All outputs when L2CR[14–15] = 00 All outputs when L2CR[14–15] = 01 All outputs when L2CR[14–15] = 10 All outputs when L2CR[14–15] = 11	t_{L2CHOV}	 — — — —	 3.1 3.2 3.3 3.7	ns	3, 4
Output hold times: All outputs when L2CR[14–15] = 00 All outputs when L2CR[14–15] = 01 All outputs when L2CR[14–15] = 10 All outputs when L2CR[14–15] = 11	t_{L2CHOX}	 0.5 0.7 0.9 1.1	 — — — —	ns	3

Figure 9 shows the L2 bus output timing diagrams for the MPC755.

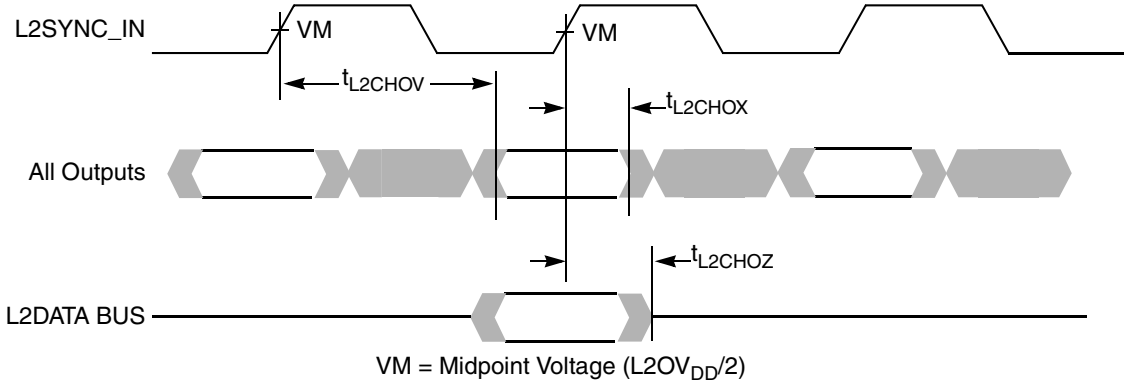


Figure 9. L2 Bus Output Timing Diagrams

Figure 10 provides the AC test load for L2 interface of the MPC755.

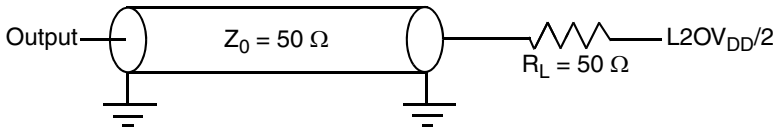


Figure 10. AC Test Load for the L2 Interface

Figure 15 provides the test access port timing diagram.

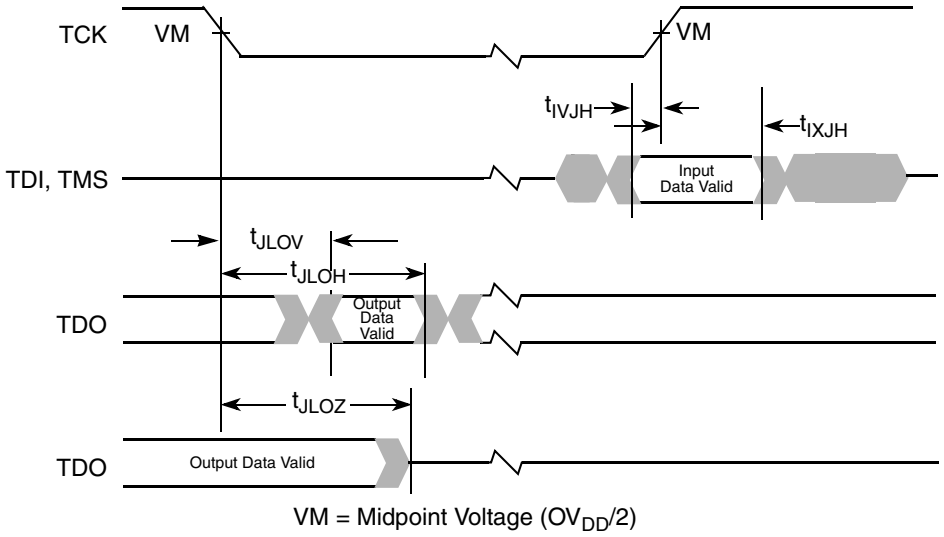
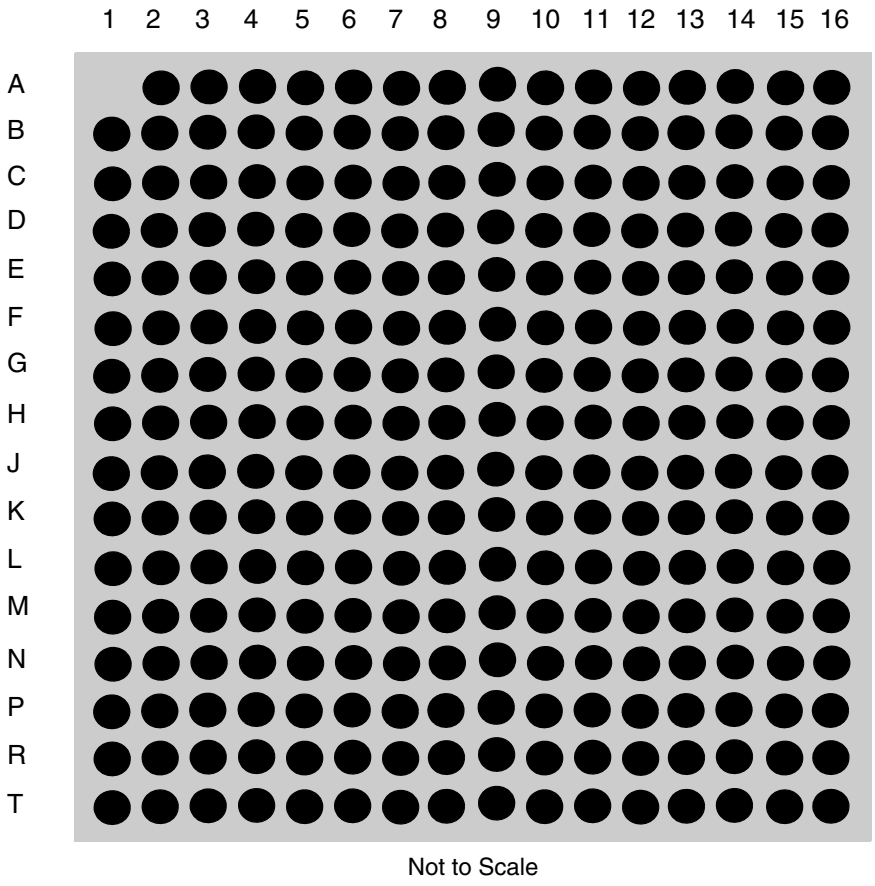


Figure 15. Test Access Port Timing Diagram

5 Pin Assignments

Figure 16 (in Part A) shows the pinout of the MPC745, 255 PBGA package as viewed from the top surface. Part B shows the side profile of the PBGA package to indicate the direction of the top surface view.

Part A



Part B

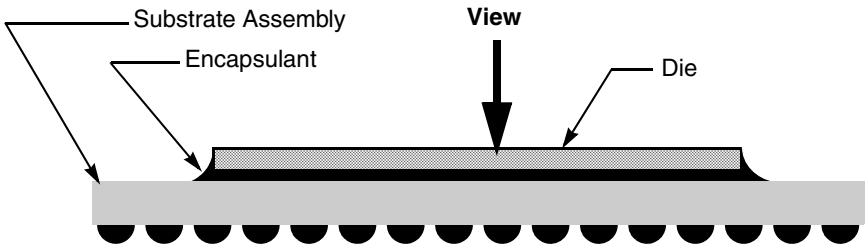


Figure 16. Pinout of the MPC745, 255 PBGA Package as Viewed from the Top Surface

6 Pinout Listings

Table 14 provides the pinout listing for the MPC745, 255 PBGA package.

Table 14. Pinout Listing for the MPC745, 255 PBGA Package

Signal Name	Pin Number	Active	I/O	I/F Voltage [1]	Notes
A[0:31]	C16, E4, D13, F2, D14, G1, D15, E2, D16, D4, E13, G2, E15, H1, E16, H2, F13, J1, F14, J2, F15, H3, F16, F4, G13, K1, G15, K2, H16, M1, J15, P1	High	I/O	OV_{DD}	
$\overline{\text{AACK}}$	L2	Low	Input	OV_{DD}	
$\overline{\text{ABB}}$	K4	Low	I/O	OV_{DD}	
AP[0:3]	C1, B4, B3, B2	High	I/O	OV_{DD}	
$\overline{\text{ARTRY}}$	J4	Low	I/O	OV_{DD}	
AV_{DD}	A10	—	—	2.0 V	
$\overline{\text{BG}}$	L1	Low	Input	OV_{DD}	
$\overline{\text{BR}}$	B6	Low	Output	OV_{DD}	
BVSEL	B1	High	Input	OV_{DD}	3, 4, 5
$\overline{\text{CI}}$	E1	Low	Output	OV_{DD}	
$\overline{\text{CKSTP\_IN}}$	D8	Low	Input	OV_{DD}	
$\overline{\text{CKSTP\_OUT}}$	A6	Low	Output	OV_{DD}	
CLK_OUT	D7	—	Output	OV_{DD}	
$\overline{\text{DBB}}$	J14	Low	I/O	OV_{DD}	
$\overline{\text{DBG}}$	N1	Low	Input	OV_{DD}	
$\overline{\text{DBDIS}}$	H15	Low	Input	OV_{DD}	
$\overline{\text{DBWO}}$	G4	Low	Input	OV_{DD}	
DH[0:31]	P14, T16, R15, T15, R13, R12, P11, N11, R11, T12, T11, R10, P9, N9, T10, R9, T9, P8, N8, R8, T8, N7, R7, T7, P6, N6, R6, T6, R5, N5, T5, T4	High	I/O	OV_{DD}	
DL[0:31]	K13, K15, K16, L16, L15, L13, L14, M16, M15, M13, N16, N15, N13, N14, P16, P15, R16, R14, T14, N10, P13, N12, T13, P3, N3, N4, R3, T1, T2, P4, T3, R4	High	I/O	OV_{DD}	
DP[0:7]	M2, L3, N2, L4, R1, P2, M4, R2	High	I/O	OV_{DD}	
$\overline{\text{DRTRY}}$	G16	Low	Input	OV_{DD}	
$\overline{\text{GBL}}$	F1	Low	I/O	OV_{DD}	
GND	C5, C12, E3, E6, E8, E9, E11, E14, F5, F7, F10, F12, G6, G8, G9, G11, H5, H7, H10, H12, J5, J7, J10, J12, K6, K8, K9, K11, L5, L7, L10, L12, M3, M6, M8, M9, M11, M14, P5, P12	—	—	GND	
$\overline{\text{HRESET}}$	A7	Low	Input	OV_{DD}	

Table 15. Pinout Listing for the MPC755, 360 BGA Package (continued)

Signal Name	Pin Number	Active	I/O	I/F Voltage [1]	Notes
L2ZZ	G17	High	Output	$L2OV_{DD}$	
$\overline{\text{LSSD\_MODE}}$	F9	Low	Input	—	2
$\overline{\text{MCP}}$	B11	Low	Input	OV_{DD}	
NC (No Connect)	B3, B4, B5, W19, K9, K11 [4], K19 [4]	—	—	—	
OV_{DD}	D5, D8, D12, E4, E6, E9, E11, F5, H4, J5, L5, M4, P5, R4, R6, R9, R11, T5, T8, T12	—	—	OV_{DD}	
PLL_CFG[0:3]	A4, A5, A6, A7	High	Input	OV_{DD}	
$\overline{\text{QACK}}$	B2	Low	Input	OV_{DD}	
$\overline{\text{QREQ}}$	J3	Low	Output	OV_{DD}	
$\overline{\text{RSRV}}$	D3	Low	Output	OV_{DD}	
$\overline{\text{SMI}}$	A12	Low	Input	OV_{DD}	
$\overline{\text{SRESET}}$	E10	Low	Input	OV_{DD}	
SYSCLK	H9	—	Input	OV_{DD}	
$\overline{\text{TA}}$	F1	Low	Input	OV_{DD}	
TBEN	A2	High	Input	OV_{DD}	
$\overline{\text{TBST}}$	A11	Low	I/O	OV_{DD}	
TCK	B10	High	Input	OV_{DD}	
TDI	B7	High	Input	OV_{DD}	6
TDO	D9	High	Output	OV_{DD}	
$\overline{\text{TEA}}$	J1	Low	Input	OV_{DD}	
$\overline{\text{TLBISYNC}}$	A3	Low	Input	OV_{DD}	
TMS	C8	High	Input	OV_{DD}	6
$\overline{\text{TRST}}$	A10	Low	Input	OV_{DD}	6
$\overline{\text{TS}}$	K7	Low	I/O	OV_{DD}	
TSIZ[0:2]	A9, B9, C9	High	Output	OV_{DD}	
TT[0:4]	C10, D11, B12, C12, F11	High	I/O	OV_{DD}	
$\overline{\text{WT}}$	C3	Low	Output	OV_{DD}	
V_{DD}	G8, G10, G12, J8, J10, J12, L8, L10, L12, N8, N10, N12	—	—	2.0 V	

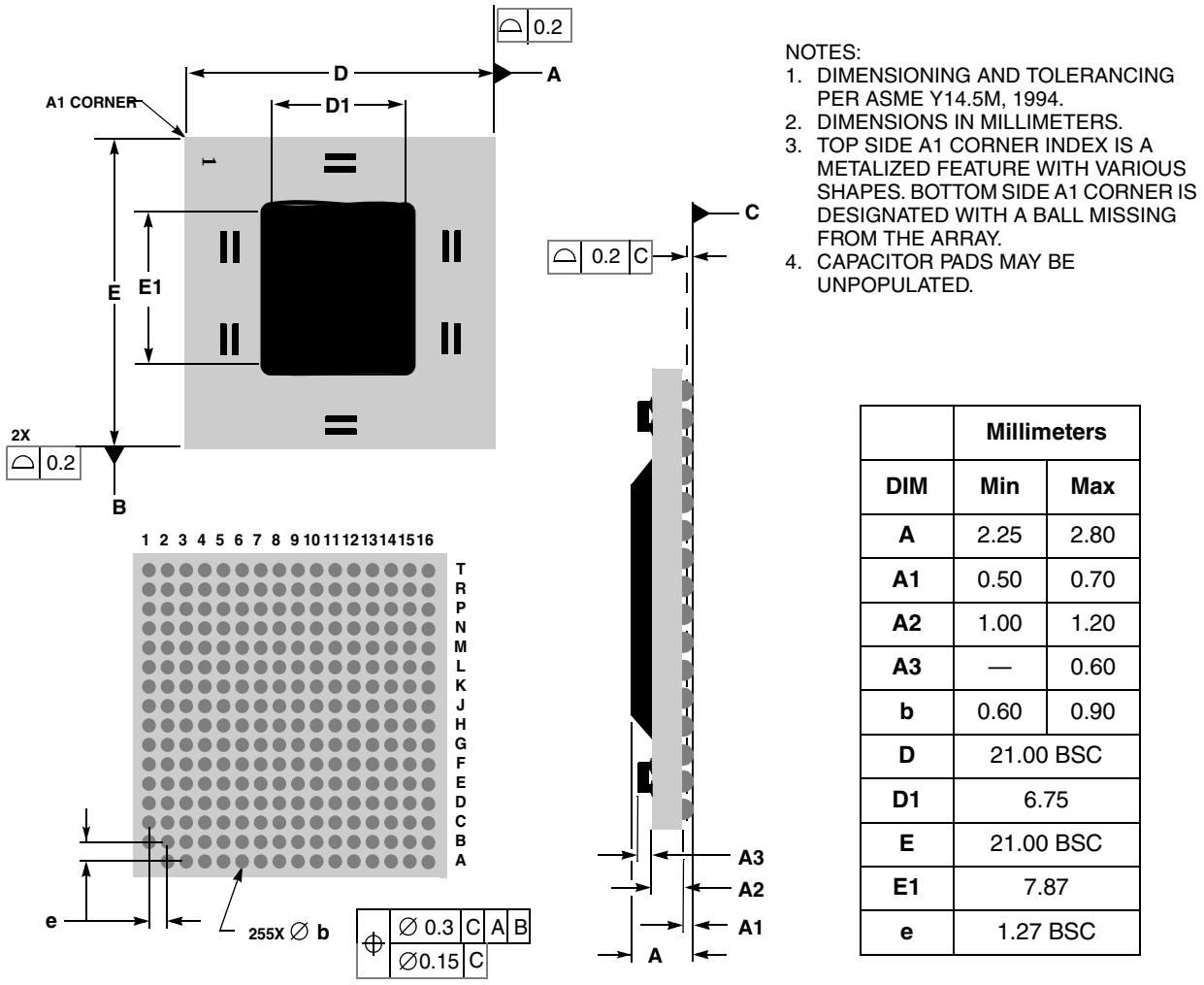
7.1 Package Parameters for the MPC745 PBGA

The package parameters are as provided in the following list. The package type is 21 × 21 mm, 255-lead plastic ball grid array (PBGA).

Package outline	21 × 21 mm
Interconnects	255 (16 × 16 ball array – 1)
Pitch	1.27 mm (50 mil)
Minimum module height	2.25 mm
Maximum module height	2.80 mm
Ball diameter (typical)	0.75 mm (29.5 mil)

7.2 Mechanical Dimensions for the MPC745 PBGA

Figure 18 provides the mechanical dimensions and bottom surface nomenclature for the MPC745, 255 PBGA package.



	Millimeters	
DIM	Min	Max
A	2.25	2.80
A1	0.50	0.70
A2	1.00	1.20
A3	—	0.60
b	0.60	0.90
D	21.00 BSC	
D1	6.75	
E	21.00 BSC	
E1	7.87	
e	1.27 BSC	

Figure 18. Mechanical Dimensions and Bottom Surface Nomenclature for the MPC745, 255 PBGA Package

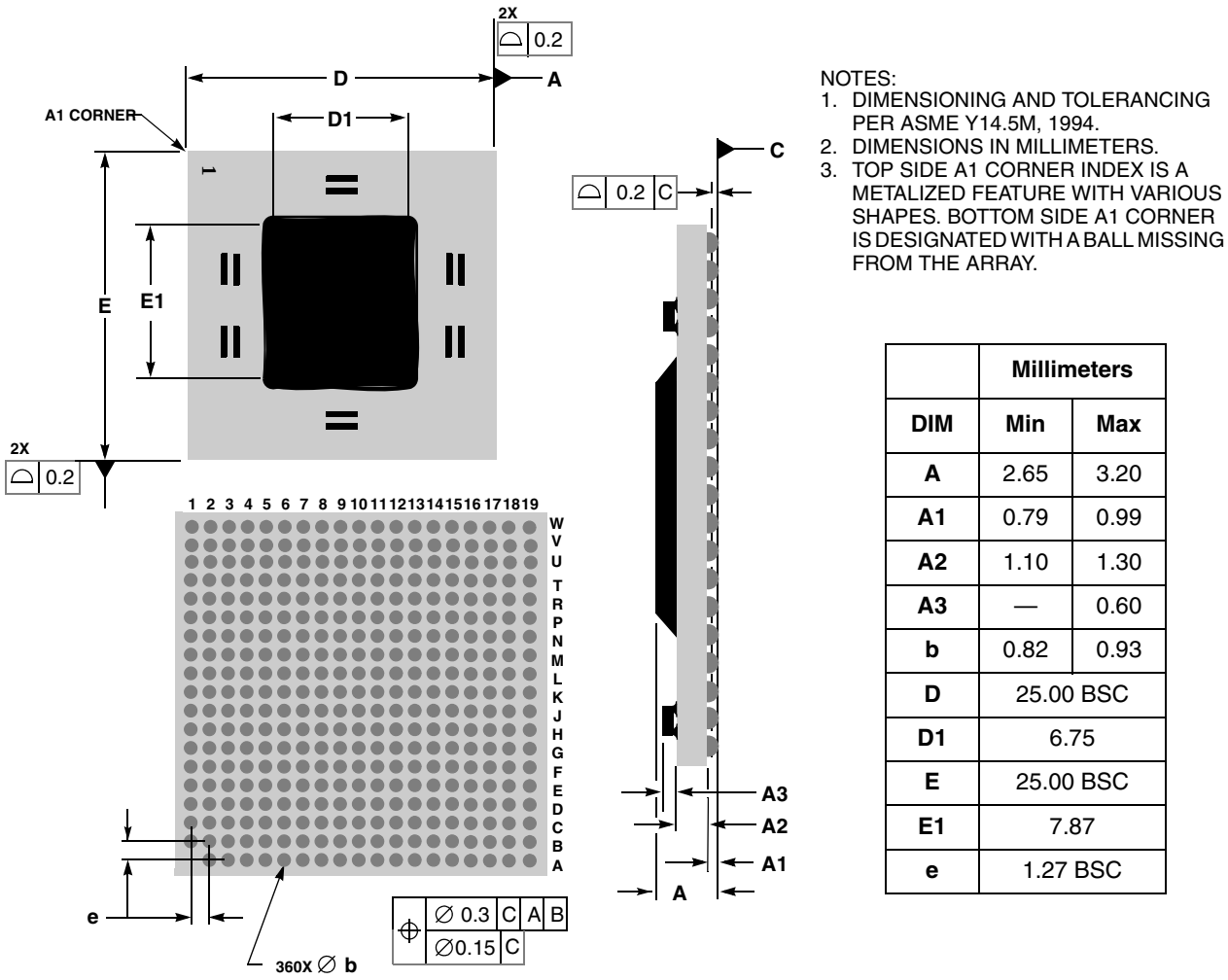
7.3 Package Parameters for the MPC755 CBGA

The package parameters are as provided in the following list. The package type is 25 × 25 mm, 360-lead ceramic ball grid array (CBGA).

Package outline	25 × 25 mm
Interconnects	360 (19 × 19 ball array – 1)
Pitch	1.27 mm (50 mil)
Minimum module height	2.65 mm
Maximum module height	3.20 mm
Ball diameter	0.89 mm (35 mil)

7.4 Mechanical Dimensions for the MPC755 CBGA

Figure 19 provides the mechanical dimensions and bottom surface nomenclature for the MPC755, 360 CBGA package.



NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. DIMENSIONS IN MILLIMETERS.
3. TOP SIDE A1 CORNER INDEX IS A METALIZED FEATURE WITH VARIOUS SHAPES. BOTTOM SIDE A1 CORNER IS DESIGNATED WITH A BALL MISSING FROM THE ARRAY.

	Millimeters	
DIM	Min	Max
A	2.65	3.20
A1	0.79	0.99
A2	1.10	1.30
A3	—	0.60
b	0.82	0.93
D	25.00 BSC	
D1	6.75	
E	25.00 BSC	
E1	7.87	
e	1.27 BSC	

Figure 19. Mechanical Dimensions and Bottom Surface Nomenclature for the MPC755, 360 CBGA Package

Table 16. MPC755 Microprocessor PLL Configuration Example for 400 MHz Parts (continued)

PLL_CFG [0:3]	Example Bus-to-Core Frequency in MHz (VCO Frequency in MHz)							
	Bus-to-Core Multiplier	Core-to-VCO Multiplier	Bus 33 MHz	Bus 50 MHz	Bus 66 MHz	Bus 75 MHz	Bus 80 MHz	Bus 100 MHz
0011	PLL off/bypass		PLL off, SYSCLK clocks core circuitry directly, 1x bus-to-core implied					
1111	PLL off		PLL off, no core clocking occurs					

Notes:

1. PLL_CFG[0:3] settings not listed are reserved.
2. The sample bus-to-core frequencies shown are for reference only. Some PLL configurations may select bus, core, or VCO frequencies which are not useful, not supported, or not tested for by the MPC755; see Section 4.2.1, "Clock AC Specifications," for valid SYSCLK, core, and VCO frequencies.
3. In PLL-bypass mode, the SYSCLK input signal clocks the internal processor directly, the PLL is disabled, and the bus mode is set for 1:1 mode operation. This mode is intended for factory use and emulator tool use only.
   Note: The AC timing specifications given in this document do not apply in PLL-bypass mode.
4. In PLL off mode, no clocking occurs inside the MPC755 regardless of the SYSCLK input.

The MPC755 generates the clock for the external L2 synchronous data SRAMs by dividing the core clock frequency of the MPC755. The divided-down clock is then phase-adjusted by an on-chip delay-lock-loop (DLL) circuit and should be routed from the MPC755 to the external RAMs. A separate clock output, L2SYNC_OUT is sent out half the distance to the SRAMs and then returned as an input to the DLL on pin L2SYNC_IN so that the rising-edge of the clock as seen at the external RAMs can be aligned to the clocking of the internal latches in the L2 bus interface.

The core-to-L2 frequency divisor for the L2 PLL is selected through the L2CLK bits of the L2CR register. Generally, the divisor must be chosen according to the frequency supported by the external RAMs, the frequency of the MPC755 core, and the phase adjustment range that the L2 DLL supports. Table 17 shows various example L2 clock frequencies that can be obtained for a given set of core frequencies. The minimum L2 frequency target is 80 MHz.

Table 17. Sample Core-to-L2 Frequencies

Core Frequency (MHz)	÷1	÷1.5	÷2	÷2.5	÷3
250	250	166	125	100	83
266	266	177	133	106	89
275	275	183	138	110	92
300	300	200	150	120	100
325	325	217	163	130	108
333	333	222	167	133	111
350	350	233	175	140	117
366	366	244	183	146	122

Table 18 summarizes the signal impedance results. The driver impedance values were characterized at 0°, 65°, and 105°C. The impedance increases with junction temperature and is relatively unaffected by bus voltage.

Table 18. Impedance Characteristics

V_{DD} = 2.0 V, OV_{DD} = 3.3 V, T_j = 0°–105°C

Impedance	Processor Bus	L2 Bus	Symbol	Unit
R_N	25–36	25–36	Z_0	Ω
R_P	26–39	26–39	Z_0	Ω

8.6 Pull-Up Resistor Requirements

The MPC755 requires pull-up resistors (1–5 kΩ) on several control pins of the bus interface to maintain the control signals in the negated state after they have been actively negated and released by the MPC755 or other bus masters. These pins are $\overline{TS}$, $\overline{ABB}$, $\overline{AACK}$, $\overline{ARTRY}$, $\overline{DBB}$, $\overline{DBWO}$, $\overline{TA}$, $\overline{TEA}$, and $\overline{DBDIS}$. $\overline{DRTRY}$ should also be connected to a pull-up resistor (1–5 kΩ) if it will be used by the system; otherwise, this signal should be connected to $\overline{HRESET}$ to select NO-DRTRY mode (see the *MPC750 RISC Microprocessor Family User's Manual* for more information on this mode).

Three test pins also require pull-up resistors (100 Ω–1 kΩ). These pins are L1_TSTCLK, L2_TSTCLK, and $\overline{LSSD\_MODE}$. These signals are for factory use only and must be pulled up to OV_{DD} for normal machine operation.

In addition, $\overline{CKSTP\_OUT}$ is an open-drain style output that requires a pull-up resistor (1–5 kΩ) if it is used by the system.

During inactive periods on the bus, the address and transfer attributes may not be driven by any master and may, therefore, float in the high-impedance state for relatively long periods of time. Since the MPC755 must continually monitor these signals for snooping, this float condition may cause additional power draw by the input receivers on the MPC755 or by other receivers in the system. These signals can be pulled up through weak (10-kΩ) pull-up resistors by the system or may be otherwise driven by the system during inactive periods of the bus to avoid this additional power draw, but address bus pull-up resistors are not necessary for proper device operation. The snooped address and transfer attribute inputs are: A[0:31], AP[0:3], TT[0:4], $\overline{TBST}$, and $\overline{GBL}$.

The data bus input receivers are normally turned off when no read operation is in progress and, therefore, do not require pull-up resistors on the bus. Other data bus receivers in the system, however, may require pull-ups, or that those signals be otherwise driven by the system during inactive periods by the system. The data bus signals are: DH[0:31], DL[0:31], and DP[0:7].

If 32-bit data bus mode is selected, the input receivers of the unused data and parity bits will be disabled, and their outputs will drive logic zeros when they would otherwise normally be driven. For this mode, these pins do not require pull-up resistors, and should be left unconnected by the system to minimize possible output switching.

If address or data parity is not used by the system, and the respective parity checking is disabled through HID0, the input receivers for those pins are disabled, and those pins do not require pull-up resistors and

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8.8.3 Heat Sink Selection Example

This section provides a heat sink selection example using one of the commercially-available heat sinks. For preliminary heat sink sizing, the die-junction temperature can be expressed as follows:

$$T_j = T_a + T_r + (\theta_{jc} + \theta_{int} + \theta_{sa}) \times P_d$$

where:

T_j is the die-junction temperature
T_a is the inlet cabinet ambient temperature
T_r is the air temperature rise within the computer cabinet
θ_{jc} is the junction-to-case thermal resistance
θ_{int} is the adhesive or interface material thermal resistance
θ_{sa} is the heat sink base-to-ambient thermal resistance
P_d is the power dissipated by the device

During operation the die-junction temperatures (T_j) should be maintained less than the value specified in Table 3. The temperature of air cooling the component greatly depends on the ambient inlet air temperature and the air temperature rise within the electronic cabinet. An electronic cabinet inlet-air temperature (T_a) may range from 30° to 40°C. The air temperature rise within a cabinet (T_r) may be in the range of 5° to 10°C. The thermal resistance of the thermal interface material (θ_{int}) is typically about 1°C/W. Assuming a T_a of 30°C, a T_r of 5°C, a CBGA package $R_{\theta jc} < 0.1$, and a power consumption (P_d) of 5.0 W, the following expression for T_j is obtained:

Die-junction temperature: $T_j = 30°C + 5°C + (0.1°C/W + 1.0°C/W + \theta_{sa}) \times 5.0\ W$

For a Thermalloy heat sink #2328B, the heat sink-to-ambient thermal resistance (θ_{sa}) versus airflow velocity is shown in Figure 28.

Assuming an air velocity of 0.5 m/s, we have an effective R_{sa} of 7°C/W, thus

$$T_j = 30°C + 5°C + (0.1°C/W + 1.0°C/W + 7°C/W) \times 5.0\ W,$$

resulting in a die-junction temperature of approximately 76°C which is well within the maximum operating temperature of the component.

Other heat sinks offered by Aavid Thermalloy, Alpha Novatech, The Bergquist Company, IERC, Chip Coolers, and Wakefield Engineering offer different heat sink-to-ambient thermal resistances, and may or may not need airflow.

Table 19. Document Revision History (continued)

Revision	Date	Substantive Change(s)
1	—	Corrected errors in Section 1.2.
		Removed references to MPC745 CBGA package in Sections 1.3 and 1.4.
		Added airflow values for θ_{JA} to Table 5.
		Corrected V_{IH} maximum for 1.8 V mode in Table 6.
		Power consumption values added to Table 7.
		Corrected t_{MXRH} in Table 9, deleted Note 2 application note reference.
		Added Max f_{L2CLK} and Min t_{L2CLK} values to Table 11.
		Updated timing values in Table 12.
		Corrected Note 2 of Table 13.
		Changed Table 14 to reflect I/F voltages supported.
		Removed 133 and 150 MHz columns from Table 16.
		Added document reference to Section 1.7.
		Added $\overline{\text{DBB}}$ to list of signals requiring pull-ups in Section 1.8.7.
		Removed log entries from Table 20 for revisions prior to public release.
0	—	Product announced. Documentation made publicly available.

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