MOTOROLA
SEMICONDUCTOR TECHNICAL DATA

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Advance Information

256KB and 512KB BurstRAM™ Secondary Cache Modules for PowerPC™ PReP/CHRP Platforms

MPC2104
MPC2105
MPC2106
MPC2107

The MPC2104/5/6/7 are designed to provide burstable, high performance L2 cache for the PowerPC 60x microprocessor family in conformance with the PowerPC Reference Platform (PReP) and the PowerPC Common Hardware Reference Platform (CHRP) specifications. These products utilize synchronous or asynchronous data RAMs.

The MPC2104, MPC2105, and MPC2106 utilize synchronous BurstRAMs. The modules are configured as 32K x 72, 64K x 72, and 128K x 72 bits in a 182 (91 x 2) pin DIMM format. The MPC2104 uses four of Motorola's 5 V 32K x 18; the MPC2105 uses four of the 5 V 64K x 18; the MPC2106 uses eight of the 5 V 64K x 18. For tag bits, a 5 V cache tag RAM configured as 16K x 12 for tag field plus 16K x 2 for valid and dirty status bits is used.

Bursts can be initiated with the ADS signal. Subsequent burst addresses are generated internal to the BurstRAM by the CNTEN signal.

Write cycles are internally self timed and are initiated by the rising edge of the clock (CLKx) inputs. Eight write enables are provided for byte write control.

The MPC2107 utilizes asynchronous data RAMs. The module is configured as 32K x 64 in the same 182 pin DIMM format. Again, 5 V cache tag RAMs configured as 16K x 12 for tag field plus 16K x 2 for valid and dirty status bits are used. Burst capability is provided in that two burst addresses bypass the address latch.

Presence detect pins are available for auto configuration of the cache control. A serial EEPROM is optional to provide more in–depth description of the cache module. This EEPROM will be available on future revisions of the module family.

The module family pinout will support 5 V and 3.3 V components for a clear path to lower voltage and power savings. Both power supplies must be connected.

All of these cache modules are plug and pin compatible with each other.

- PowerPC–style Burst Counter on Chip (MPC2104/5/6)
- Flow–Through Data I/O (MPC2104/5/6)
- Plug and Pin Compatibility of entire Module Family
- Multiple Clock Pins for Reduced Loading
- All Cache Data and Tag I/Os are LVTTL (3.3 V) Compatible (MPC2104/5/6)
- Three State Outputs
- Byte Write Capability
- Fast Module Clock Rates: Up to 66 MHz
- Fast SRAM Access Times: 10 ns for Tag RAM Match
  9 ns for Data RAM (MPC2104/5/6)
  15 ns for Data RAM (MPC2107)
- Decoupling Capacitors for Each Fast Static RAM
- High Quality Multi–Layer FR4 PWB With Separate Power and Ground Planes
- 182 Pin Card Edge Module
- Burndy Connector, Part Number: ELF182JSC–3Z50

BurstRAM is a trademark of Motorola.
PowerPC is a trademark of International Business Machines Corp.

This document contains information on a new product. Specifications and information herein are subject to change without notice.

11/8/95

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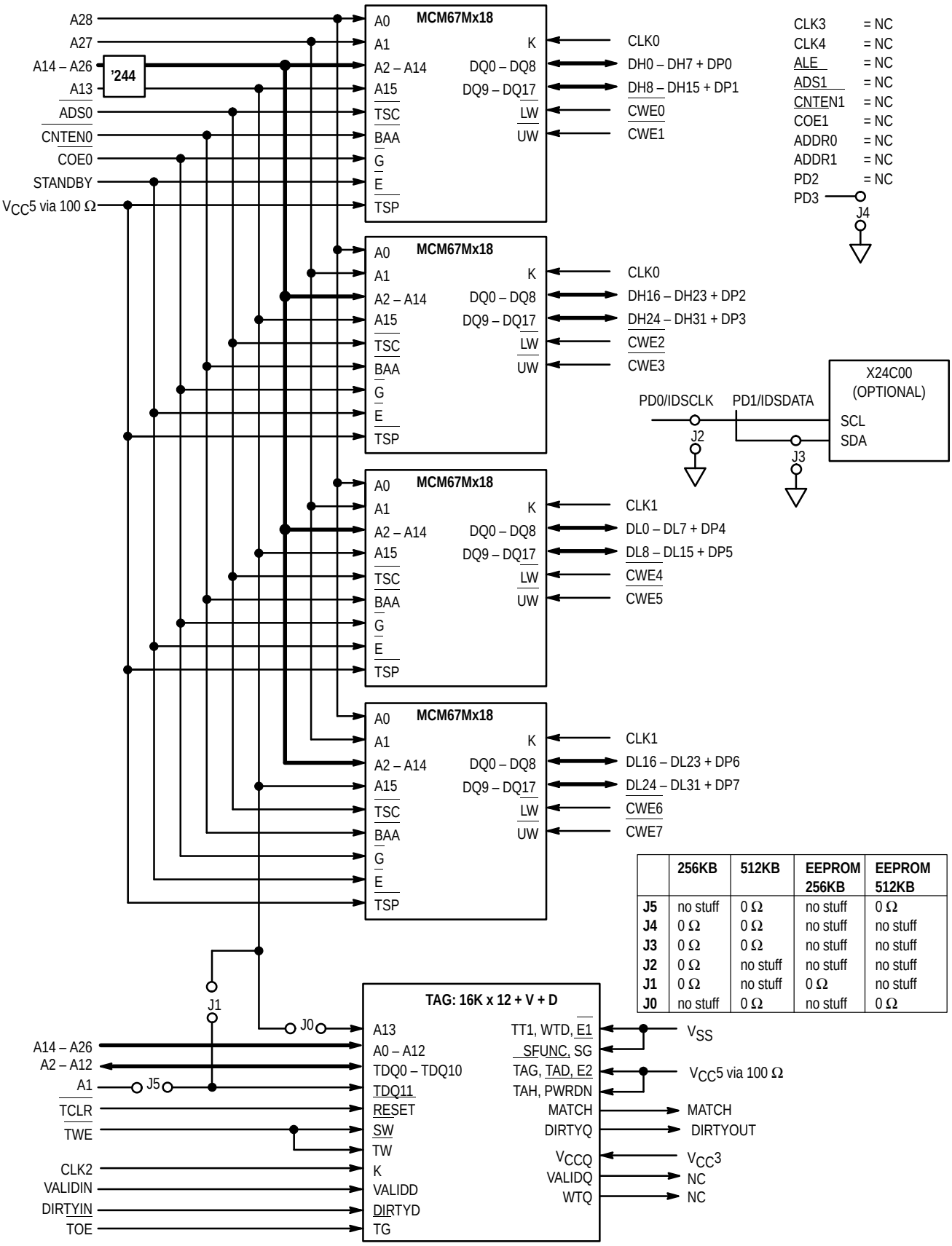
PIN ASSIGNMENT
182–LEAD DIMM
TOP VIEW – CASE TBD

V_{SS}	92	1	V_{SS}
PD1/IDSDATA	93	2	PD0/IDSCLK
PD3	94	3	PD2
DH31	95	4	DH30
DH29	96	5	DH28
DH27	97	6	DH26
DH25	98	7	DH24
$V_{CC}3$	99	8	$V_{CC}3$
CWE3	100	9	DP3
DH23	101	10	DH22
DH21	102	11	DH20
DH18	103	12	DH19
V_{SS}	104	13	V_{SS}
DH16	105	14	DH17
CWE2	106	15	DP2
DH14	107	16	DH15
DH13	108	17	DH12
$V_{CC}5$	109	18	$V_{CC}5$
DH10	110	19	DH11
DH8	111	20	DH9
CWE1	112	21	DP1
DH6	113	22	DH7
$V_{CC}3$	114	23	$V_{CC}3$
DH4	115	24	DH5
V_{SS}	116	25	DH3
CLK0	117	26	DH2
V_{SS}	118	27	DH0
DH1	119	28	DP0
CWE0	120	29	V_{SS}
DL31	121	30	CLK1
DL30	122	31	VSS
V_{SS}	123	32	DL28
DL29	124	33	DL26
DL27	125	34	DL24
DL25	126	35	DP7
$V_{CC}5$	127	36	$V_{CC}5$
CWE7	128	37	DL22
DL23	129	38	DL20
DL21	130	39	DL18
DL19	131	40	DL16
V_{SS}	132	41	V_{SS}
DL17	133	42	DP6
CWE6	134	43	DL14
DL15	135	44	DL12
DL13	136	45	DL11
V_{SS}	137	46	V_{SS}
DL10	138	47	DL9
DL8	139	48	DP5
CWE5	140	49	DL7
DL6	141	50	DL4
$V_{CC}3$	142	51	$V_{CC}3$
DL5	143	52	DL3
DL2	144	53	DL1
V_{SS}	145	54	DL0
CLK3	146	55	V_{SS}
V_{SS}	147	56	CLK2
CLK4	148	57	V_{SS}
V_{SS}	149	58	DP4
CWE4	150	59	COE0
ALE	151	60	COE1
$V_{CC}3$	152	61	$V_{CC}3$
ADDR1	153	62	ADDR0
RESERVED	154	63	RESERVED
CNTEN0	155	64	ADS0
CNTEN1	156	65	ADS1
$V_{CC}5$	157	66	$V_{CC}5$
$V_{CC}5$	158	67	$V_{CC}5$
A27	159	68	A28
A24	160	69	A26
A22	161	70	A25
A20	162	71	A23
V_{SS}	163	72	V_{SS}
A18	164	73	A21
A16	165	74	A19
A15	166	75	A17
A14	167	76	A13
$V_{CC}3$	168	77	$V_{CC}3$
A10	169	78	A12
A8	170	79	A11
A6	171	80	A9
V_{SS}	172	81	V_{SS}
A4	173	82	A7
A2	174	83	A5
A1	175	84	A3
BURSTMODE	176	85	A0
$V_{CC}5$	177	86	$V_{CC}5$
VALIDIN	178	87	TCLR
TWE	179	88	MATCH
STANDBY	180	89	TOE
DIRTYOUT	181	90	DIRTYIN
V_{SS}	182	91	V_{SS}

NOTES:
1. $V_{CC}5$ and $V_{CC}3$ must be connected on all modules.

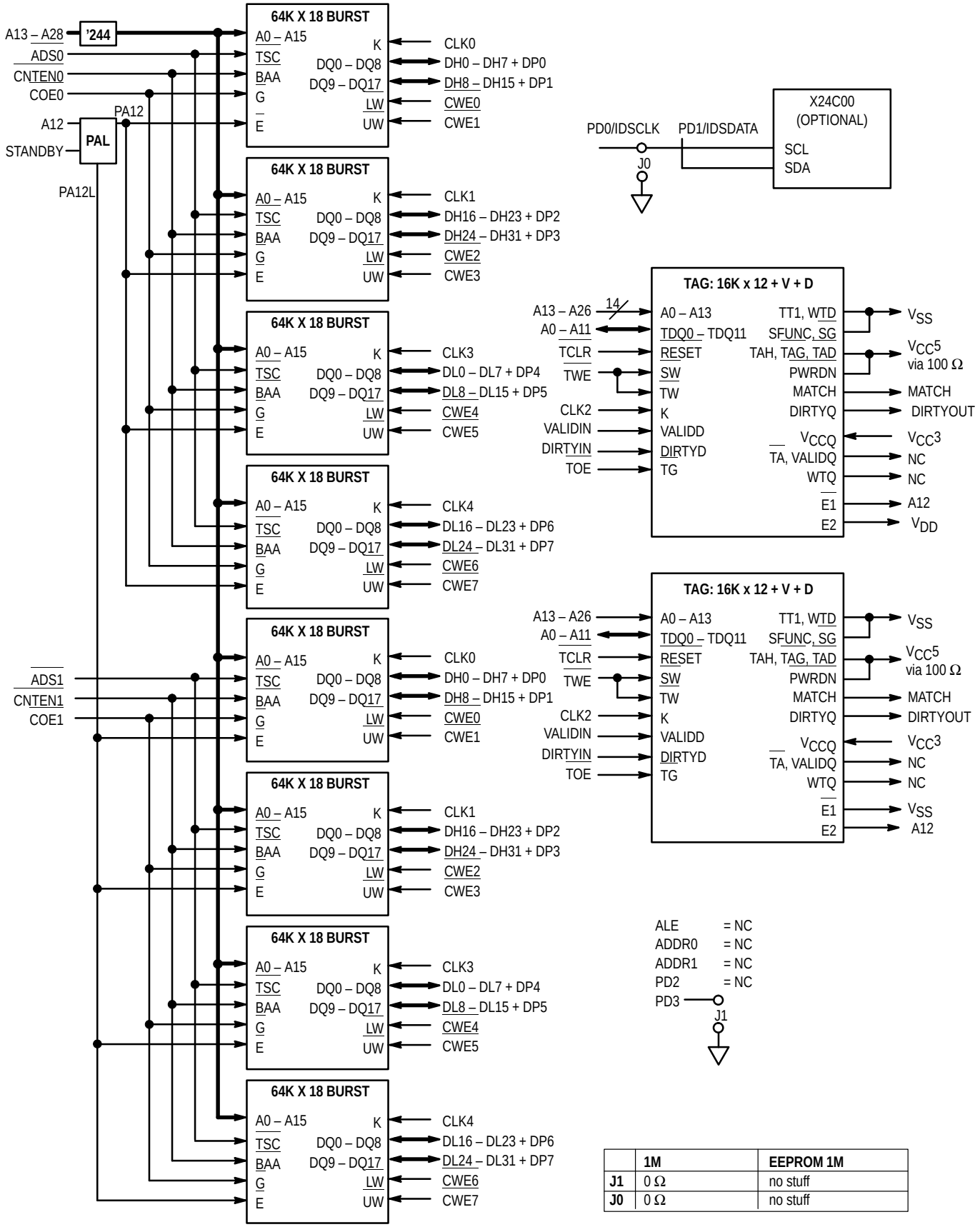
MPC2104/MPC2105 BLOCK DIAGRAM



	256KB	512KB	EEPROM 256KB	EEPROM 512KB
J5	no stuff	0 Ω	no stuff	0 Ω
J4	0 Ω	0 Ω	no stuff	no stuff
J3	0 Ω	0 Ω	no stuff	no stuff
J2	0 Ω	no stuff	no stuff	no stuff
J1	0 Ω	no stuff	0 Ω	no stuff
J0	no stuff	0 Ω	no stuff	0 Ω

Note: MPC2104 utilizes 32K x 18 BurstRAMs. MPC2105 utilizes 64K x 18 BurstRAMs.

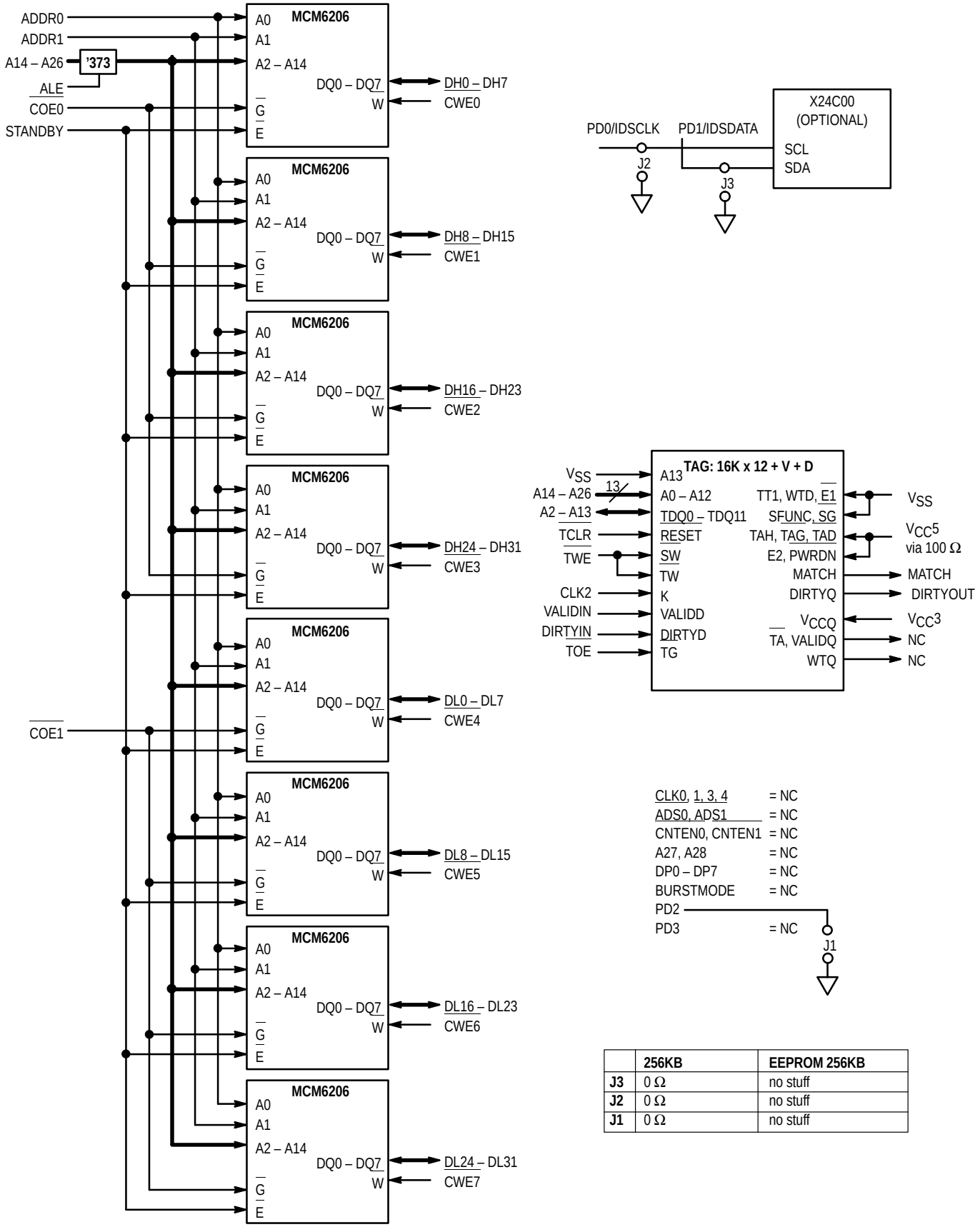
MPC2106 BLOCK DIAGRAM



	1M	EEPROM 1M
J1	0 Ω	no stuff
J0	0 Ω	no stuff

Note: All 64K X 18 TSP signals are tied to V_{CC} via a 100 Ω resistor. Edge connector A28 connects to the 64K x 18 A0; edge connector A27 connects to the 64K x 18 A1.

MPC2107 BLOCK DIAGRAM



	256KB	EEPROM 256KB
J3	0 Ω	no stuff
J2	0 Ω	no stuff
J1	0 Ω	no stuff

PIN DESCRIPTIONS

Pin Locations	Symbol	Type	Description
68, 69, 70, 71, 73, 74, 75, 76, 78, 79, 80, 82, 83, 84, 85, 159, 160, 161, 162, 164, 165, 166, 167, 169, 170, 171, 173, 174, 175	A0 – A28	Input	Address Inputs – (MSB:0, LSB:28)
62	ADDR0	Input	Least significant address bit when asynchronous Data RAMs are used.
153	ADDR1	Input	Next to least significant address bit when asynchronous Data RAMs are used.
30, 56, 117, 146, 148	CLK0 – CLK4	Input	Clock Inputs – CLK2 is for Tag RAM, CLK0, 1, 3, and 4 are for Data RAMs only. For MPC2106 use all the clocks. For MPC2104 or MPC2105 use CLK0–CLK2 only. For MPC2107 use CLK2 only.
4, 5, 6, 7, 10, 11, 12, 14, 16, 17, 19, 20, 22, 24, 25, 26, 27, 95, 96, 97, 98, 101, 102, 103, 105, 107, 108, 110, 111, 113, 115, 119	DH0 – DH31	I/O	High Data Bus – (MSB:0, LSB:31)
32, 33, 34, 37, 38, 39, 40, 43, 44, 45, 47, 49, 50, 52, 53, 54, 121, 122, 124, 125, 126, 129, 130, 131, 133, 135, 136, 138, 139, 141, 143, 144	DL0 – DL31	I/O	Low Data Bus – (MSB:0, LSB:31)
9, 15, 21, 28, 35, 42, 48, 58	DP0 – DP7	I/O	Data Parity Bits – (MSB:0, LSB:7)
3, 94	PD2, PD3	Output	Presence detect bits.
2	PD0/IDSCLK	Input	Presence detect bit 0/EEPROM serial clock. (EEPROM option only.)
93	PD1/IDSDATA	I/O	Presence detect bit 1/EEPROM serial data. (EEPROM option only.)
64, 65	$\overline{ADS0}$, $\overline{ADS1}$	Input	Data RAM Address Strobe – For MPC2104 or MPC2105 use $\overline{ADS0}$ only. For MPC2106 use $\overline{ADS0}$, $\overline{ADS1}$.
151	ALE	Input	Data RAM Address Latch Enable – Use for asynchronous Data RAM only.
155, 156	$\overline{CNTEN0}$, $\overline{CNTEN1}$	Input	Data RAM Count Enables – For MPC2104 or MPC2105 use $\overline{CNTEN0}$ only. For MPC2106 use $\overline{CNTEN0}$, $\overline{CNTEN1}$.
59, 60	$\overline{COE0}$, $\overline{COE1}$	Input	Data RAM Output Enables – For MPC2104 or MPC2105 use $\overline{COE0}$ only. For all others use $\overline{COE0}$, $\overline{COE1}$.
100, 106, 112, 120, 128, 134, 140, 150	$\overline{CWE0}$ – $\overline{CWE7}$	Input	Data RAM Write Enables – (MSB:0, LSB:7)
87	TCLR	Input	Tag RAM clear.
88	MATCH	Output	Tag RAM active high match indication.
178	VALIDIN	Input	Tag RAM valid bit.
179	$\overline{TWE}$	Input	Tag RAM write enable.
89	$\overline{TOE}$	Input	Tag RAM output enable.
90	DIRTYIN	Input	Dirty input bit.
181	DIRTYOUT	Output	Dirty output bit.
180	STANDBY	Input	Standby pin. Reduces standby power consumption.
176, 63, 154	RESERVED		Reserved pin.
8, 23, 51, 61, 77, 99, 114, 142, 152, 168	$V_{CC}3$	Input	+ 3.3 V power supply. Must be connected.
18, 36, 66, 67, 86, 109, 127, 157, 158, 177	$V_{CC}5$	Input	+ 5 V power supply. Must be connected.
1, 13, 29, 31, 41, 46, 55, 57, 72, 81, 91, 92, 104, 116, 118, 123, 132, 137, 145, 147, 149, 163, 172, 182	V_{SS}	Input	Ground
176	BURSTMODE	Input	Burstmode. 0 = Linear, 1 = Interleaved.

DATA RAM MCM67M518, MCM67M618 SYNCHRONOUS TRUTH TABLE (See Notes 1, 2, and 3)

STANDBY	ADS0	CNTEN0	CWEx	CLKx	Address Used	Operation
H	L	X	X	L–H	N/A	Deselected
L	L	X	L	L–H	External Address	Write Cycle, Begin Burst
L	L	X	H	L–H	External Address	Read Cycle, Begin Burst
X	H	L	L	L–H	Next Address	Write Cycle, Continue Burst
X	H	L	H	L–H	Next Address	Read Cycle, Continue Burst
X	H	H	L	L–H	Current Address	Write Cycle, Suspend Burst
X	H	H	H	L–H	Current Address	Read Cycle, Suspend Burst

NOTES:
1. X means Don't Care.
2. All inputs except COE must meet set–up and hold times for the low–to–high transition of clock (CLK0 – CLK4).
3. Wait states are inserted by suspending burst.

ASYNCHRONOUS TRUTH TABLE (See Notes 1 and 2)

Operation	COE	I/O Status
Read	L	Data Out (DQ0 – DQ8)
Read	H	High–Z
Write	X	High–Z — Data In
Deselected	X	High–Z

NOTES:
1. X means Don't Care.
2. For a write operation following a read operation, $\overline{\text{COE}}$ must be high before the input data required set–up time and held high through the input data hold time.

DATA RAM MCM6206 ASYNCHRONOUS TRUTH TABLE (See Notes 1 and 2)

STANDBY	COE0, COE1	CWE0 – CWE7	Operation	I/O Status
H	X	X	Deselected	High–Z
L	H	H	Output Disabled	High–Z
L	L	H	Read	Data Out
L	X	L	Write	High–Z

NOTES:
1. X means Don't Care.
2. For a write operation following a read operation, $\overline{\text{COE0}}$, and $\overline{\text{COE1}}$ must be high before the input data required set–up time, and held high through the input data hold time.

ABSOLUTE MAXIMUM RATINGS (Voltages Referenced to V_{SS} = 0 V)

Rating		Symbol	Value	Unit
Power Supply Voltage		V_{CC}	– 0.5 to + 7.0	V
Voltage Relative to V_{SS}		V_{in}, V_{out}	– 0.5 to V_{CC} + 0.5	V
Output Current (per I/O)	Data RAM Tag	I_{out}	± 30 ± 20	mA
Power Dissipation		P_D	8.1	W
Temperature Under Bias		T_{bias}	– 10 to + 85	°C
Operating Temperature		T_A	0 to +70	°C
Storage Temperature		T_{stg}	– 55 to + 125	°C

NOTE: Permanent device damage may occur if ABSOLUTE MAXIMUM RATINGS are exceeded. Functional operation should be restricted to RECOMMENDED OPERATING CONDITIONS. Exposure to higher than recommended voltages for extended periods of time could affect device reliability.

This device contains circuitry to protect the inputs against damage due to high static voltages or electric fields; however, it is advised that normal precautions be taken to avoid application of any voltage higher than maximum rated voltages to this high–impedance circuit.

This BiCMOS memory circuit has been designed to meet the dc and ac specifications shown in the tables, after thermal equilibrium has been established.

This device contains circuitry that will ensure the output devices are in High–Z at power up.

DC OPERATING CONDITIONS AND CHARACTERISTICS

(V_{CC} = 5.0 V ± 5%, T_A = 0 to + 70°C, Unless Otherwise Noted)

RECOMMENDED OPERATING CONDITIONS (Voltages referenced to V_{SS} = 0 V)

Parameter	Symbol	Min	Max	Unit
Supply Voltage (Operating Voltage Range)	V_{CC}	4.75	5.25	V
Input High Voltage	V_{IH}	2.2	V_{CC} + 0.3**	V
Input Low Voltage	V_{IL}	– 0.5*	0.8	V

* V_{IL} (min) = – 0.5 V dc; V_{IL} (min) = – 2.0 V ac (pulse width ≤ 20 ns) for I ≤ 20.0 mA.
** V_{IH} (max) = V_{CC} + 0.3 V dc; V_{IH} (max) = V_{CC} + 2.0 V ac (pulse width ≤ 20 ns) for I ≤ 20.0 mA.

DC CHARACTERISTICS

Parameter		Symbol	Min	Max	Unit
Input Leakage Current (All Inputs, V_{in} = 0 to V_{CC})	Data RAM Tag	$I_{lkg(I)}$	—	± 1.0 ± 5.0	µA
Output Leakage Current (COE = V_{IH}, V_{out} = 0 to V_{CC})	Data RAM Tag	$I_{lkg(O)}$	—	± 1.0 ± 5.0	µA
TTL Output Low Voltage (I_{OL} = + 8.0 mA)		V_{OL}	—	0.4	V
TTL Output High Voltage (I_{OH} = – 4.0 mA)		V_{OH}	2.4	—	V

POWER SUPPLY CURRENTS

Parameter		Symbol	Max	Unit
AC Supply Current (COE = V_{IH}, E = V_{IL}, I_{out} = 0 mA, All Inputs = V_{IL} and V_{IH}, V_{IL} = 0.0 V and V_{IH} ≥ 3.0 V, Cycle Time ≥ 20 ns)	MPC2104 MPC2105 MPC2106 MPC2107	I_{CCA}	 1480 1420 2840 1400	mA
AC Standby Current ($\overline{E}$ = V_{IH}, I_{out} = 0 mA, All Inputs = V_{IL} or V_{IH}, V_{IL} = 0.0 V and V_{IH} ≥ 3.0 V, Cycle Time ≥ 20 ns)	MPC2104 MPC2105 MPC2106 MPC2107	I_{SB1}	 620 700 1400 960	mA

CAPACITANCE (f = 1.0 MHz, dV = 3.0 V, T_A = 25°C, Periodically Sampled Rather Than 100% Tested)

Parameter		Symbol	Typ	Max	Unit
Input Capacitance	(A13 – A28) (Data RAM Control Pins) (CLK0 – CLK4) (Tag Control Pins)	C_{in}	— 16 8 —	15 20 10 5	pF
Tag Output Capacitance	(MATCH, DIRTYOUT)	C_{out}	—	7	pF
Data RAM Input/Output Capacitance	(DH0 – DH31, DL0 – DL31)	$C_{I/O}$	6	8	pF
Tag Input/Output Capacitance	(A0 – A11)	$C_{I/O}$	—	7	pF

DATA RAMs AC OPERATING CONDITIONS AND CHARACTERISTICS

(V_{CC} = 5.0 V ± 5% T_A = 0 to + 70°C, Unless Otherwise Noted)

Input Timing Measurement Reference Level . . . . . 1.5 V
Input Pulse Levels . . . . . 0 to 3.0 V
Input Rise/Fall Time . . . . . 3 ns

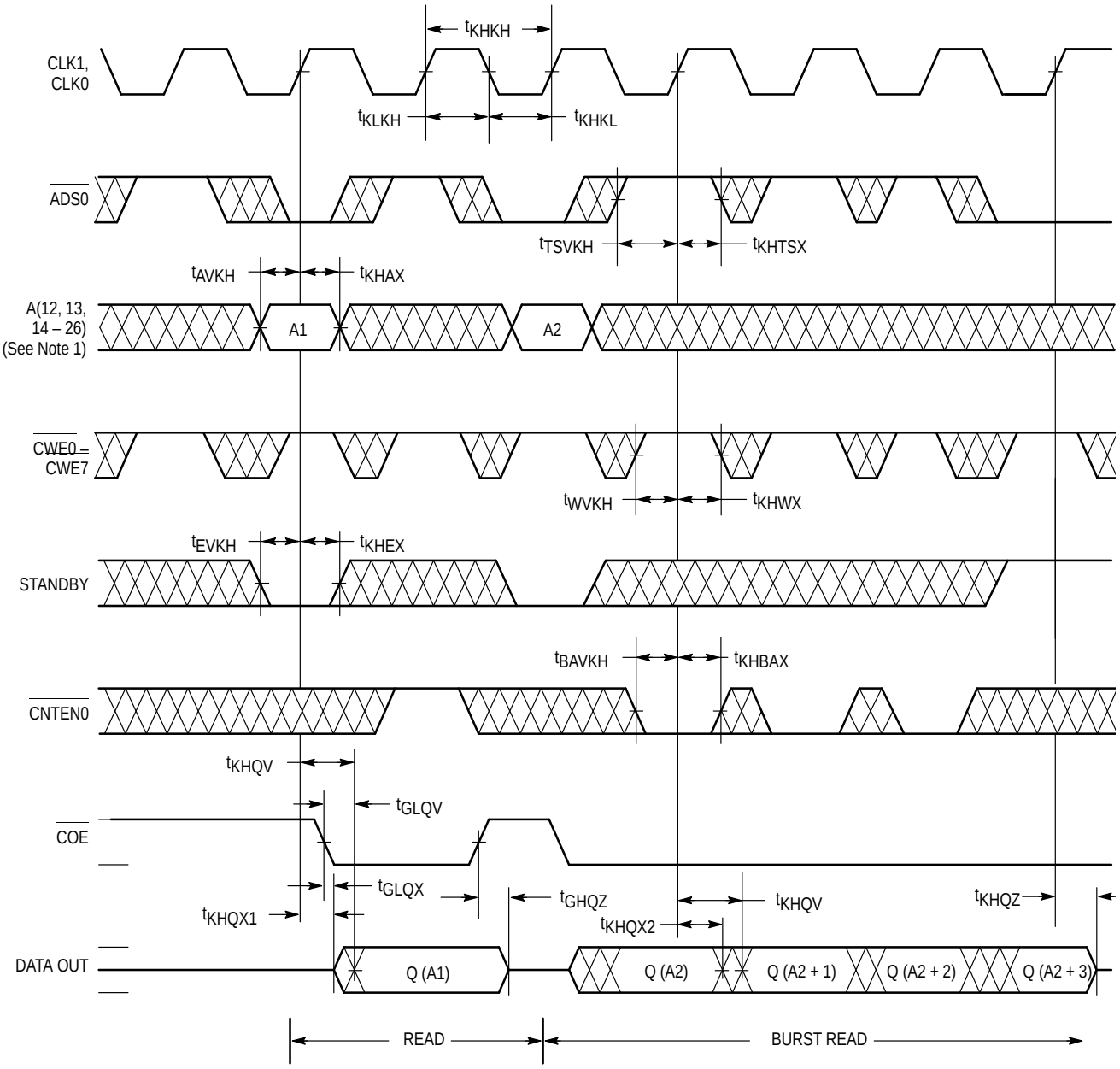
Output Timing Reference Level . . . . . 1.5 V
Output Load . . . . . See Figure 1A Unless Otherwise Noted

SYNCHRONOUS DATA RAMs READ/WRITE CYCLE TIMING (See Notes 1, 2, 3, and 7)

Parameter		Symbol	MPC2104 MPC2105 MPC2106 Min	MPC2104 MPC2105 MPC2106 Max	Unit	Notes
Cycle Time		t_{KHKH}	15	—	ns	
Clock Access Time		t_{KHQV}	—	9	ns	4
Output Enable to Output Valid		t_{GLQV}	—	5	ns	
Clock High to Output Active		t_{KHQX1}	6	—	ns	
Clock High to Output Change		t_{KHQX2}	3	—	ns	
Output Enable to Output Active		t_{GLQX}	0	—	ns	
Output Disable to Q High–Z		t_{GHQZ}	2	6	ns	
Clock High to Q High–Z		t_{KHQZ}	—	6	ns	
Clock High Pulse Width		t_{KHKL}	5	—	ns	
Clock Low Pulse Width		t_{KLKH}	5	—	ns	
Setup Time	Address	t_{AVKH}	7.5	—	ns	5, 6
Setup Times:	Address Status Data In Write Address Advance Chip Enable	t_{SVKH} t_{DVKH} t_{WVKH} t_{BAVVKH} t_{EVKH}	2.5	—	ns	5
Hold Times:	Address Address Status Data In Write Address Advance Chip Enable	t_{KHAX} t_{KHTSX} t_{KHDX} t_{KHWX} t_{KHBAX} t_{KHEX}	0.5	—	ns	5

NOTES:
1. In setup and hold times, W (write) refers to either one or both byte write enables $\overline{LW}$ and $\overline{UW}$.
2. All read and write cycle timings are referenced from CLK or COE.
3. COE is a don't care when UW or LW is sampled low.
4. Maximum access times are guaranteed for all possible PowerPC external bus cycles.
5. This is a synchronous device. All addresses must meet the specified setup and hold times for ***ALL*** rising edges of CLK whenever $\overline{TSP}$ or TSC is low, and the chip is selected. All other synchronous inputs must meet the specified setup and hold times for ***ALL*** rising edges of CLK when the chip is enabled. Chip enable must be valid at each rising edge of clock for the device (when TSP or TSC is low) to remain enabled.
6. 5 ns of set–up delay is incurred in address buffers.
7. Applies to MPC2104, MPC2105, and MPC2106.

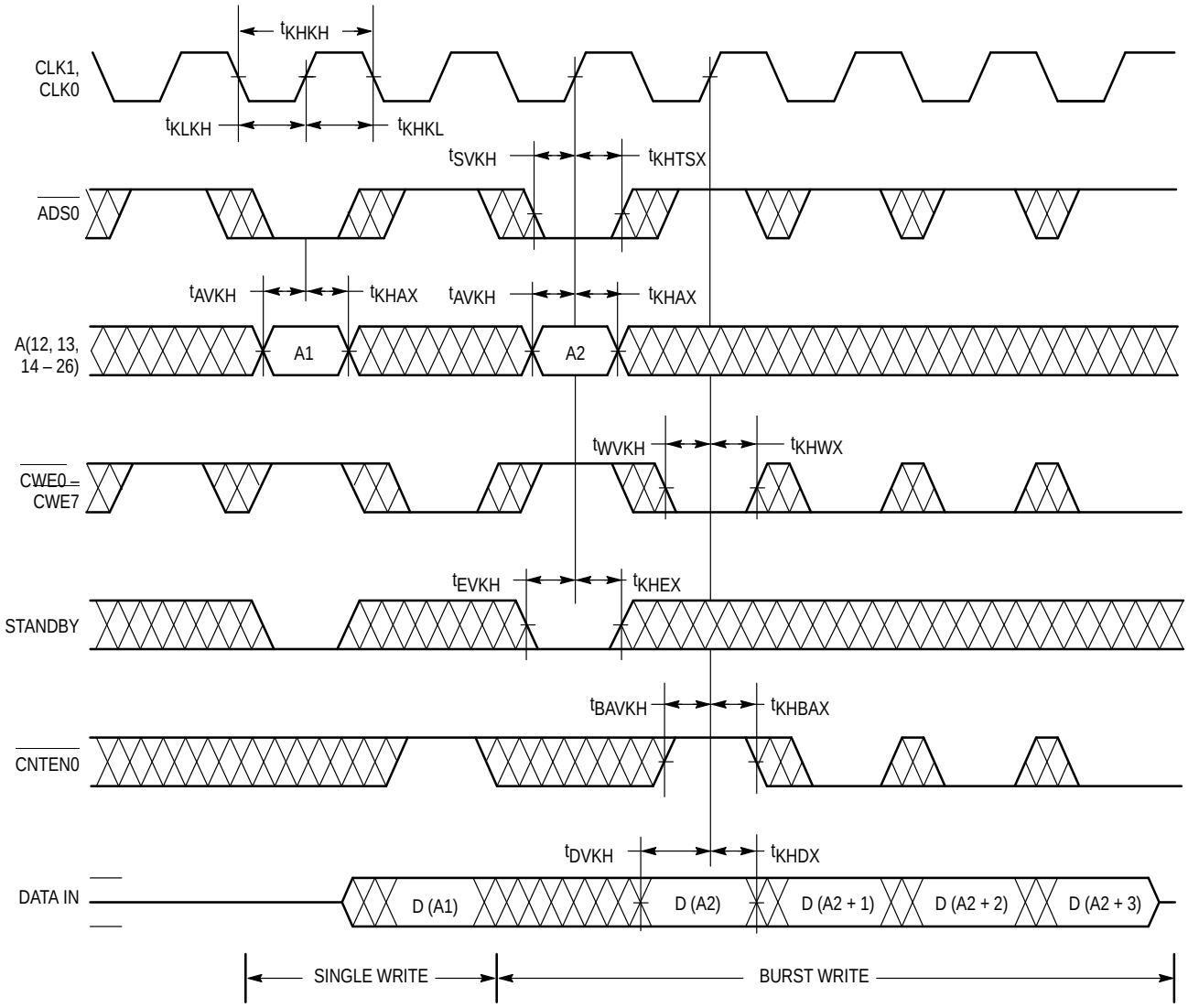
SYNCHRONOUS DATA RAM READ CYCLE



NOTES:

1. Cache addresses used are: 14 – 26 for MPC2104 and MPC2107; 13 – 26 for MPC2105; and 12 – 26 for MPC2106.
2. Q1 (A2) represents the first ouput from the external address A2; Q2 (A2) represents the next output data in the burst sequence with A2 as the base address.

SYNCHRONOUS DATA RAM WRITE CYCLE



NOTES:
1. Cache addresses used are: 14 – 26 for MPC2104 and MPC2107; 13 – 26 for MPC2105; and 12 – 26 for MPC2106.
2. $\overline{COE0} = V_{IH}$

AC OPERATING CONDITIONS AND CHARACTERISTICS

(V_{CC} = 5.0 V ± 5% T_A = 0 to + 70°C, Unless Otherwise Noted)

Input Timing Measurement Reference Level . . . . . 1.5 V
Input Pulse Levels . . . . . 0 to 3.0 V
Input Rise/Fall Time . . . . . 3 ns

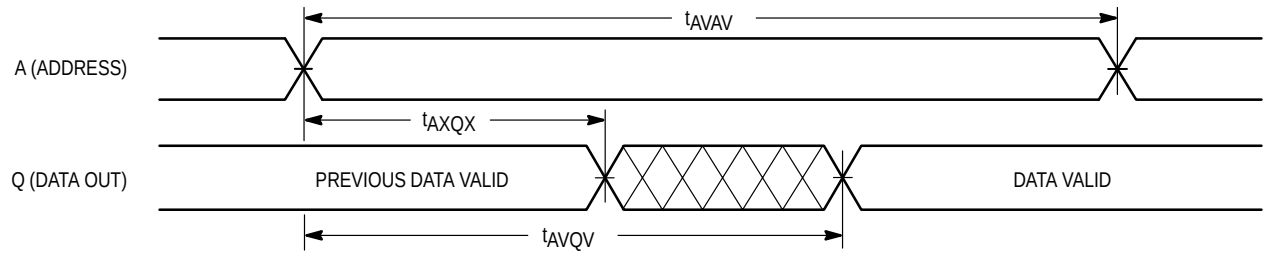
Output Timing Reference Level . . . . . 1.5 V
Output Load . . . . . See Figure 1A Unless Otherwise Noted

ASYNCHRONOUS DATA RAMs READ CYCLE TIMING (See Notes 1 and 8)

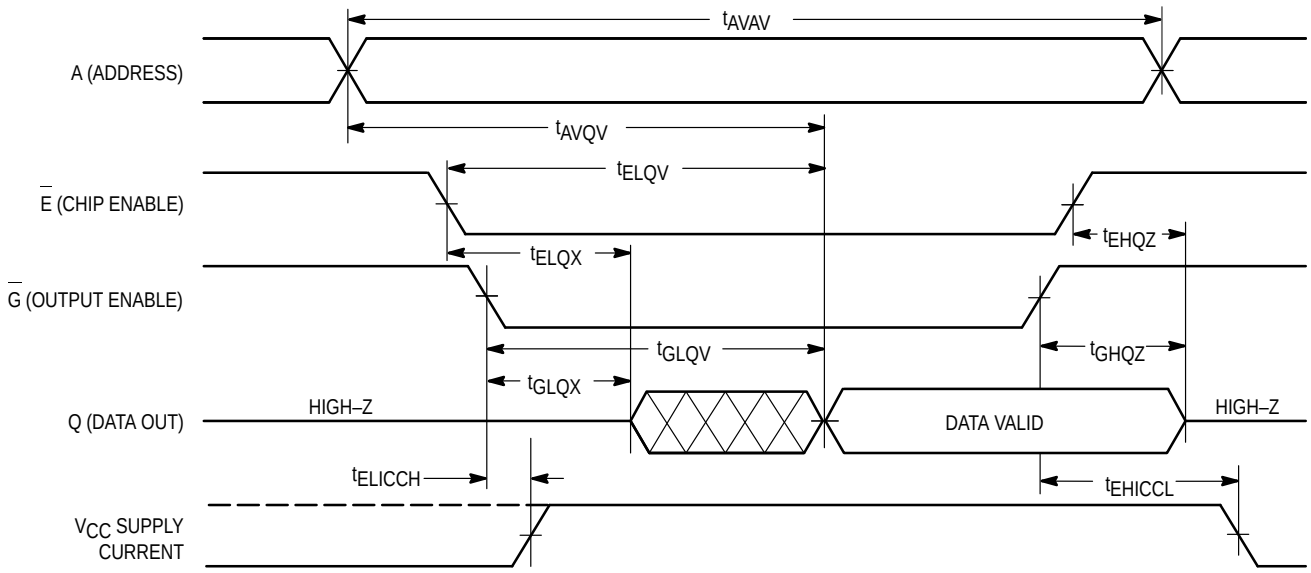
Parameter	Symbol	MPC2107–15		Unit	Notes
		Min	Max		
Cycle Time	t_{AVAV}	15	—	ns	2
Address Access Time	t_{AVQV}	—	15	ns	
Enable Access Time	t_{ELQV}	—	15	ns	3
Output Enable Access Time	t_{GLQV}	—	8	ns	
Output Hold from Address Change	t_{AXQX}	4	—	ns	4, 5, 6
Enable Low to Output Active	t_{ELQX}	4	—	ns	4, 5, 6
Enable High to Output High–Z	t_{EHQZ}	0	8	ns	4, 5, 6
Output Enable Low to Output Active	t_{GLQX}	0	—	ns	4, 5, 6
Output Enable High to Output High–Z	t_{GHQZ}	0	7	ns	4, 5, 6
Power Up Time	t_{ELICCH}	0	—	ns	
Power Down Time	t_{EHICCL}	—	15	ns	

NOTES:
1. W is high for read cycle.
2. All timings are referenced from the last valid address to the first transitioning address.
3. Addresses valid prior to or coincident with E going low.
4. At any given voltage and temperature, t_{EHQZ}(max) is less than t_{ELQX}(min), and t_{GHQZ}(max) is less than t_{GLQX}(min), both for a given device and from device to device.
5. Transition is measured ± 500 mV from steady–state voltage with load of Figure 1B.
6. This parameter is sampled and not 100% tested.
7. Device is continuously selected (E = V_{IL}, COE0 = V_{IL}).
8. Applies to MPC2107.

ASYNCHRONOUS READ CYCLE 1 (See Note 7)



ASYNCHRONOUS READ CYCLE 2 (See Note 3)

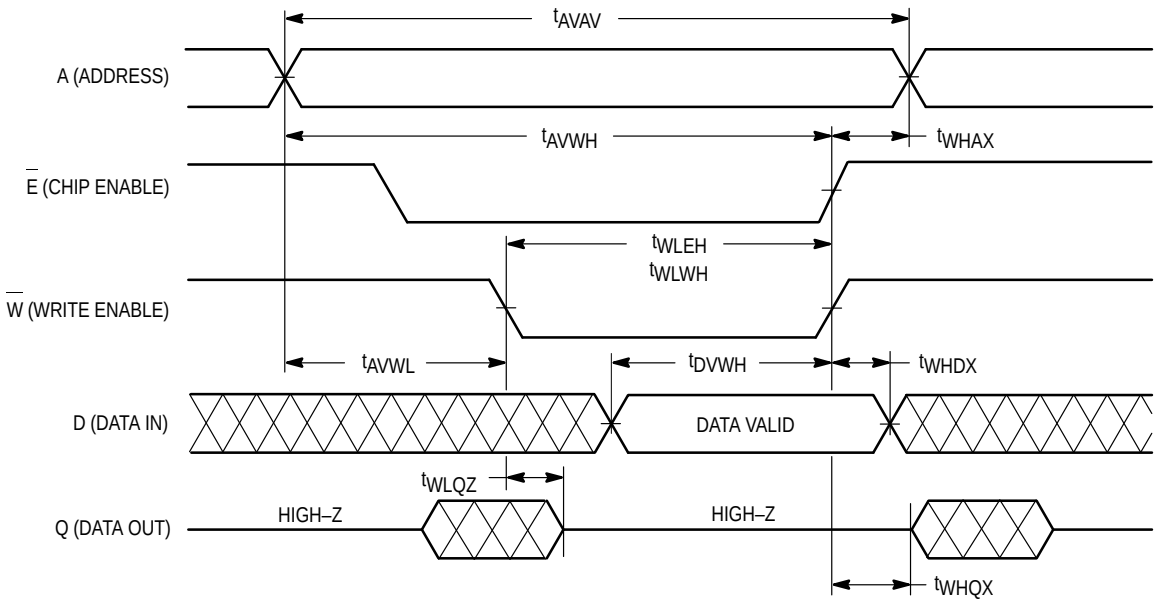


ASYNCHRONOUS DATA RAMs WRITE CYCLE 1 (See Notes 1 and 2)

Parameter	Symbol	MPC2107–15		Unit	Notes
		Min	Max		
Write Cycle Time	t_{AVAV}	15	—	ns	3
Address Set–up Time	t_{AVWL}	0	—	ns	
Address Valid to End of Write	t_{AVWH}	12	—	ns	
Write Pulse Width	t_{WLWH} t_{WLEH}	12	—	ns	
Write Pulse Width, $\overline{G}$ High	t_{WLWH} t_{WLEH}	10	—	ns	4
Data Valid to End of Write	t_{DVWH}	7	—	ns	
Data Hold Time	t_{WHDX}	0	—	ns	
Write Low to Output High–Z	t_{WLQZ}	0	7	ns	5,6,7
Write High to Output Active	t_{WHQX}	5	—	ns	5,6,7
Write Recovery Time	t_{WHAX}	0	—	ns	

NOTES:
1. A write occurs during the overlap of $\overline{E}$ low and $\overline{W}$ low.
2. If E goes low coincident with or after W goes low, the output will remain in a high impedance state.
3. All timings are referenced from the last valid address to the first transitioning address.
4. If $E \geq V_{IH}$, the output will remain in a high impedance state.
5. At any given voltage and temperature, t_{WLQZ} (max) is less than t_{WHQX} (min), both for a given device and from device to device.
6. Transition is measured ±500 mV from steady–state voltage with load of Figure 1B.
7. This parameter is sampled and not 100% tested.

ASYNCHRONOUS WRITE CYCLE 1 ($\overline{W}$ Controlled, See Notes 1 and 2)

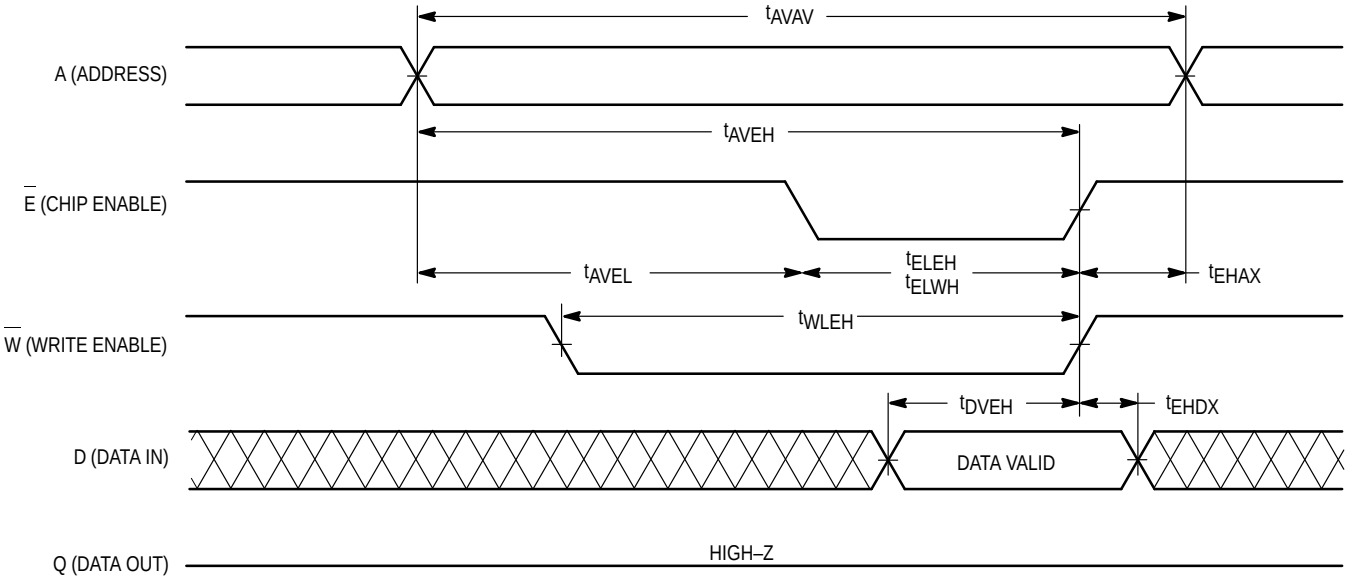


ASYNCHRONOUS DATA RAMs WRITE CYCLE 2 ($\overline{E}$ Controlled, See Notes 1 and 2)

Parameter	Symbol	MPC2107–15		Unit	Notes
		Min	Max		
Write Cycle Time	t_{AVAV}	15	—	ns	0
Address Setup Time	t_{AVEL}	0	—	ns	
Address Valid to End of Write	t_{AVEH}	12	—	ns	
Enable to End of Write	t_{ELEH} t_{ELWH}	10	—	ns	3, 4
Data Valid to End of Write	t_{DVEH}	7	—	ns	
Data Hold Time	t_{EHDX}	0	—	ns	
Write Recovery Time	t_{EHAX}	0	—	ns	

NOTES:
1. A write occurs during the overlap of $\overline{E}$ low and $\overline{W}$ low.
2. All timings are referenced from the last valid address to the first transitioning address.
3. If E goes low coincident with or after W goes low, the output will remain in a high impedance state.
4. If E goes high coincident with or before W goes high, the output will remain in a high impedance state.

ASYNCHRONOUS WRITE CYCLE 2 ($\overline{E}$ Controlled, See Note 1)



RESET FUNCTION TRUTH TABLE (See Notes 1 and 2)

TCLR	CLK	TWE	TAG	VLD_{out}	DTY_{out}	WT_{out}	MATCH	TA	Operation	POWER
L	L – H	H	High–Z	L(3)	L(3)	L(3)	L(3)	High–Z	Reset Status	Active
L	L – H	L	—	—	—	—	—	—	Not Allowed	—

NOTES:
1. H = V_{IH}, L = V_{IL}, X = don't care, — = unrelated.
2. TOE is X for this table.

READ FUNCTION TRUTH TABLE (See Notes 1, 2, and 3)

TOE	TWE	CLK	TAG	VLD_{in}	DTY_{in}	WT_{in}	VLD_{out}	DTY_{out}	WT_{out}	MATCH	Operation
L	H	X	D_{OUT}	—	—	—	—	—	—	D_{OUT}	Read Tag I/O
H	X	X	High–Z	—	—	—	—	—	—	—	Tag I/O Disable

WRITE FUNCTION TRUTH TABLE (See Notes 1 and 2)

TOE	TWE	CLK	TAG	VLD_{in}	DTY_{in}	WT_{in}	VLD_{out}	DTY_{out}	WT_{out}	MATCH	Operation
H	L	L – H	D_{IN}	—	—	—	D_{OUT}	D_{OUT}	D_{OUT}	L	Write Tag I/O
L	L	L – H	—	—	—	—	—	—	—	—	Not Allowed

NOTES:
1. H = V_{IH}, L = V_{IL}, X = don't care, — = unrelated.
2. This table applies when RESET and PWRDN are high.
3. D_{OUT} in this case is the same as D_{IN}. The input data is written through to the outputs during the write operation.

MATCH FUNCTION TRUTH TABLE (See Notes 1 through 4)

TOE	TWE	TAG	VLD(4)	DTY(4)	WT(4)	MATCH	Operation
X	X	—	—	—	—	D_{OUT}	Selected
L	H	D_{OUT}	—	—	—	L	Read Tag I/O
H	L	D_{IN}	D_{IN}	D_{IN}	D_{IN}	L	Write Tag I/O, Status Bits
H	H	TAG_{IN}	L	—	—	L	Invalid Data – Dedicated Status Bits
H	H	TAG_{IN}	H	—	—	M	Match – Dedicated Status Bits

NOTES:
1. H = V_{IH}, L = V_{IL}, X = don't care, — = unrelated.
2. M = high if TAG_{IN} equals the memory contents at the address; M = low if TAG_{IN} does not equal the ocntents at that address.
3. PWRDN and RESET are high for this table. OES and CLK are X.
4. This column represents the stored memory cell data for the given status bit at the selected address.

TAG RAM AC OPERATING CONDITIONS AND CHARACTERISTICS

(V_{CC} = 5.0 V ± 5%, T_A = 0 to + 70°C, Unless Otherwise Noted)

Input Timing Measurement Reference Level . . . . . 1.5 V
Input Pulse Levels . . . . . 0 to 3.0 V
Input Rise/Fall Time . . . . . 3 ns

Output Timing Measurement Reference Level . . . . . 1.5 V
Output Load . . . . . Figure 1A Unless Otherwise Noted

TAG RAM READ CYCLE (See Notes 1 through 4)

Parameter	Symbol	Tag RAM		Unit	Notes
		Min	Max		
Clock Access Time	t_{KHQV}	—	10	ns	
Output Enable to Output Valid	t_{GLQV}	—	8	ns	
Output Enable to Output Active	t_{GLQX}	0	—	ns	
Output Disable to Q High–Z	t_{GHQZ}	1	6	ns	
Status Bit Hold from Address Change	t_{AXSX}	3	—	ns	
Address Access Time Status Bits	t_{AVSV}	—	10	ns	
Tag Bit Hold from Address Change	t_{AVQX}	3	—	ns	
Address Access Time Tag Bits	t_{AVQV}	—	12	ns	

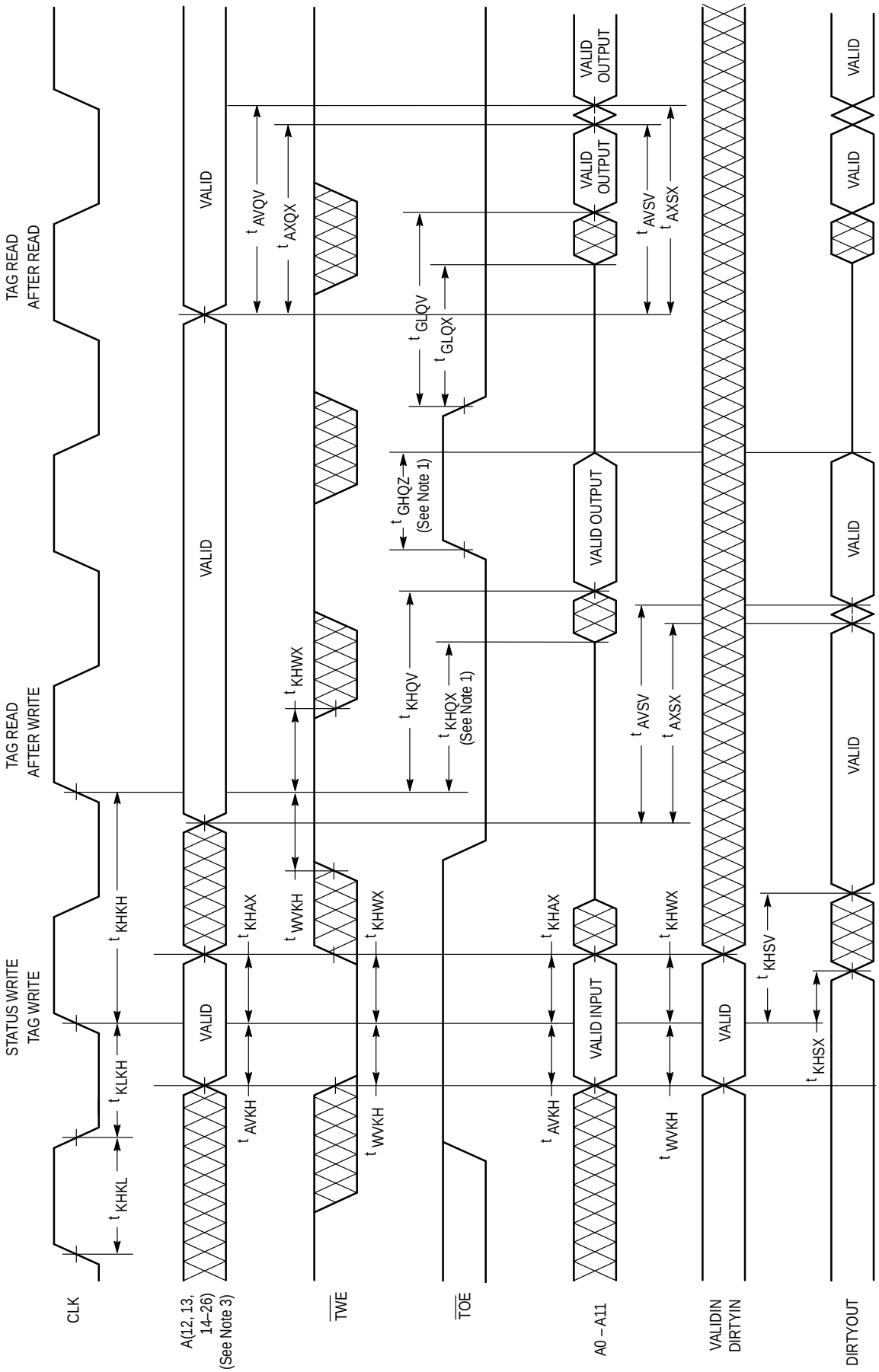
NOTES:
1. Set–up and hold times, W (write) refers to $\overline{TWE}$.
2. A read cycle is defined by $\overline{TWE}$ high. A write cycle is defined by $\overline{TWE}$ low.
3. Maximum access times are guaranteed for all possible MC68040 and PowerPC external bus cycles.
4. Tag reads are asynchronous.

TAG RAM WRITE CYCLE (See Notes 1 through 4)

Parameter	Symbol	Tag RAM		Unit	Notes
		Min	Max		
Cycle Time	t_{KHKH}	15	—	ns	
Clock High Pulse Width	t_{KHKL}	4.5	—	ns	
Clock Low Pulse Width	t_{KLKH}	4.5	—	ns	
Clock High to Output Active	t_{KHQX}	1.5	—	ns	
Set–up Times Address Write	t_{AVKH} t_{WVKH}	3	—	ns	
Hold Times Address Write	t_{KHAX} t_{KHWX}	1.5	—	ns	
Status Output Hold	t_{KHSX}	0	—	ns	
Clock High to Status Bits Valid	t_{KHSV}	—	9	ns	

NOTES:
1. Set–up and hold times, W (write) refers to $\overline{TWE}$.
2. A read cycle is defined by $\overline{TWE}$ high. A write cycle is defined by $\overline{TWE}$ low.
3. Maximum access times are guaranteed for all possible MC68040 and PowerPC external bus cycles.
4. Tag writes are synchronous.

TAG RAM WRITE AND READ CYCLES (See Note 2)



NOTE:
1. Transition is measured plus or minus 200 mV from steady state.
2. $\overline{TCLR}$ = High.
3. Cache addresses used are: 14–26 for MPC2004 and MPC2007; 13–26 for MPC2005; 12–26 for MPC2006 and MPC2009.

TAG RAM MATCH CYCLE

Parameter	Symbol	Tag RAM		Unit	Notes
		Min	Max		
Clock High Write to MATCH Invalid	t_{KHML}	—	7	ns	
Clock High Read to MATCH Valid	t_{KHMV}	—	10	ns	
Address Valid to MATCH Valid	t_{AVMV}	—	10	ns	
MATCH Valid Hold from Address Change	t_{AXMX}	2	—	ns	
$\overline{TOE}$ Low to MATCH Invalid	t_{GLML}	—	7	ns	
$\overline{TOE}$ High to MATCH Valid	t_{GHMX}	—	8	ns	

TAG RAM RESET ($\overline{TCLR}$) CYCLE

Parameter	Symbol	Tag RAM		Unit	Notes
		Min	Max		
$\overline{TCLR}$ Set–up Time	t_{STC}	4	—	ns	
$\overline{TCLR}$ Hold Time	t_{HTC}	1	—	ns	
Status Bit Reset Time	t_{SRST}	—	60	ns	
Status Bit Hold from TCLR Low	t_{SHRS}	2	—	ns	
TCLR Low to MATCH Invalid	t_{RSML}	—	10	ns	
TCLR High to MATCH Valid	t_{RSMV}	—	100	ns	
TCLR Low to TAG High–Z	t_{RSQZ}	—	10	ns	
TCLR High to TAG Active	t_{RSQX}	—	100	ns	
STANDBY Set–up to TCLR Low	t_{PDSR}	30	—	ns	
TCLR High to TWE Low	t_{RHWX}	80	—	ns	

AC TEST LOADS

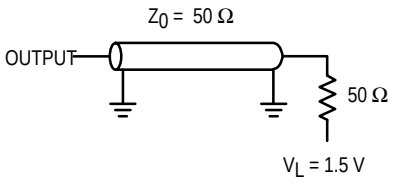


Figure 1A

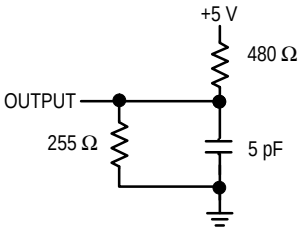
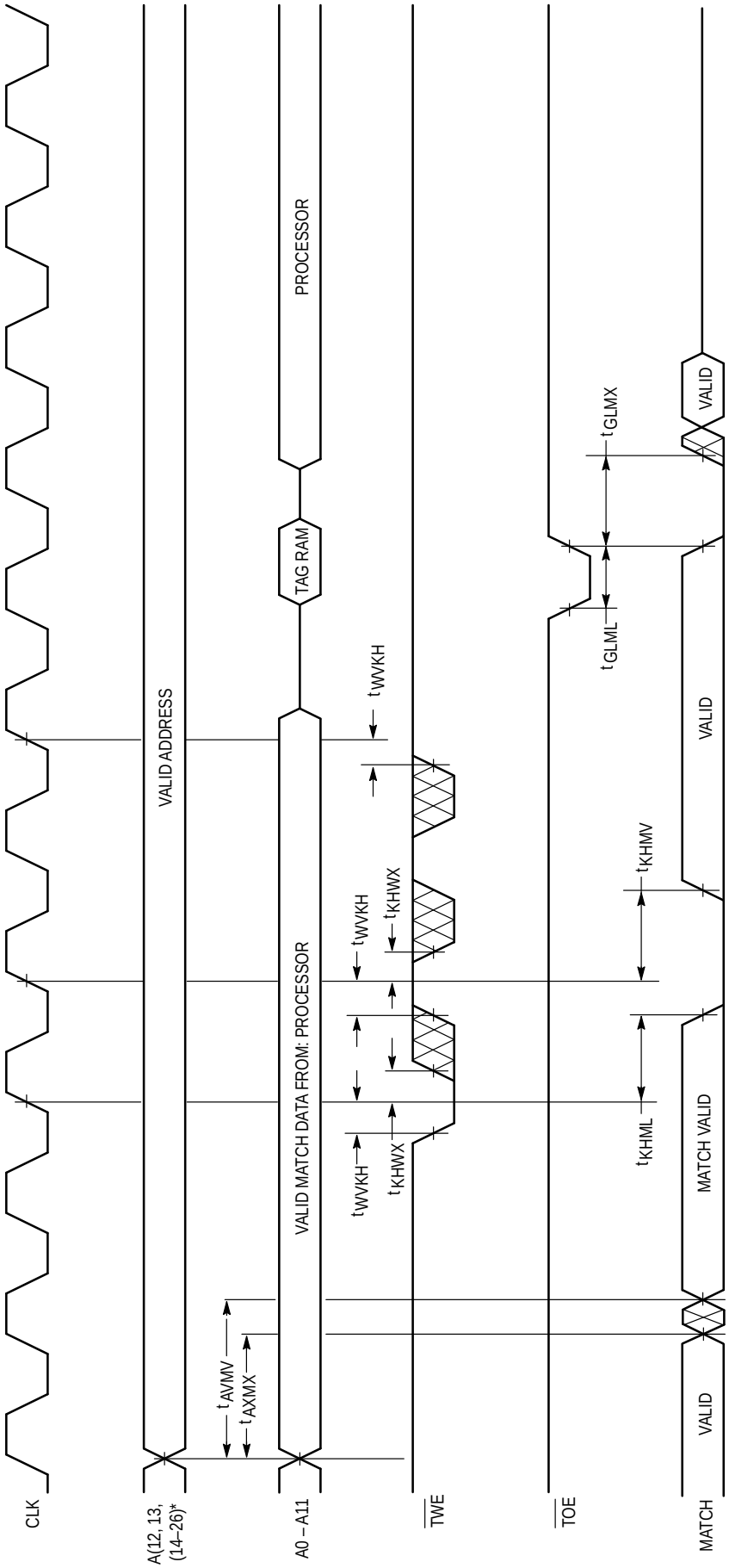


Figure 1B

TIMING LIMITS

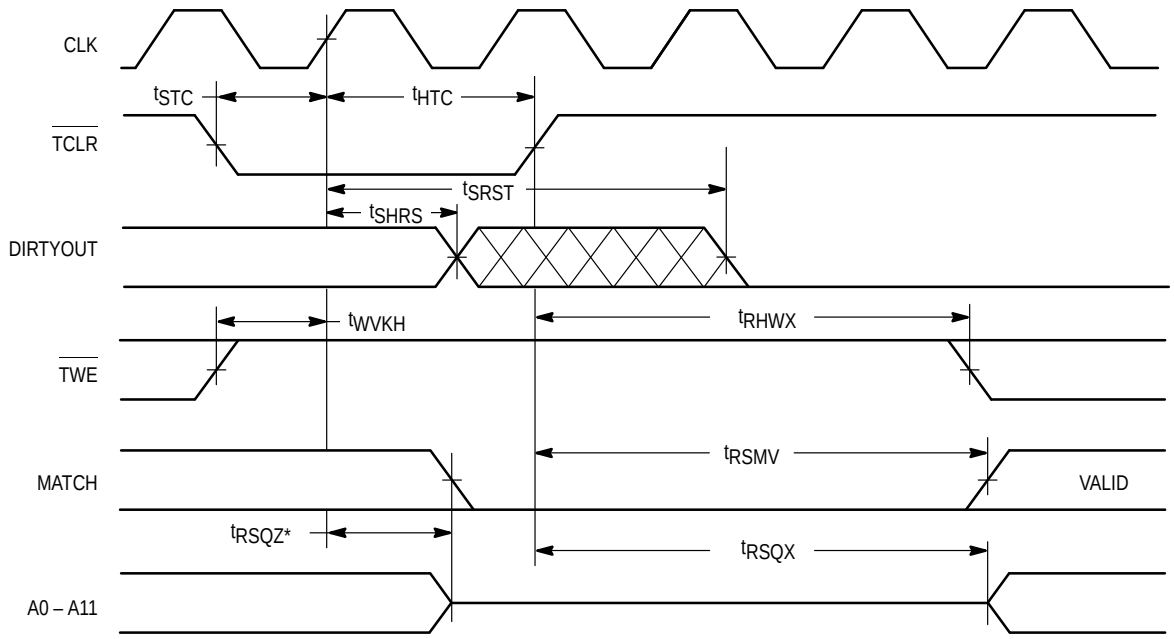
The table of timing values shows either a minimum or a maximum limit for each parameter. Input requirements are specified from the external system point of view. Thus, address setup time is shown as a minimum since the system must supply at least that much time (even though most devices do not require it). On the other hand, responses from the memory are specified from the device point of view. Thus, the access time is shown as a maximum since the device never provides data later than that time.

TAG RAM MATCH CYCLE



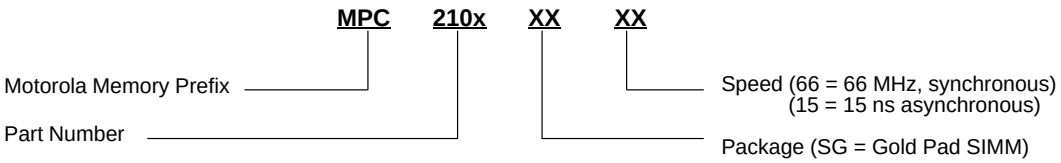
* Cache addresses used are: 14–26 for MPC2004 and MPC2007; 13–26 for MPC2005; 12–26 for MPC2006.

TAG RAM $\overline{\text{TCLR}}$ FUNCTION



* Transition is measured plus or minus 200 mV from steady state.

ORDERING INFORMATION
(Order by Full Part Number)



Full Part Numbers —	MPC2104SG66	MPC2104 = 256KB, synchronous
	MPC2105SG66	MPC2105 = 512KB, synchronous
	MPC2106SG66	MPC2106 = 1MB, synchronous
	MPC2107SG15	MPC2107 = 256KB, asynchronous

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