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CY7C09569V
CY7C09579V

3.3 V 16K/32K × 36 FLEx36® Synchronous Dual-Port Static RAM

Features

- True dual-ported memory cells which allow simultaneous access of the same memory location
- Two flow-through/pipelined devices
  - 16K × 36 organization (CY7C09569V)
  - 32K × 36 organization (CY7C09579V)
- 0.25-micron CMOS for optimum speed/power
- Three modes
  - Flow-through
  - Pipelined
  - Burst
- Bus-matching capabilities on right port (× 36 to × 18 or × 9)
- Byte-select capabilities on left port
- 100 MHz pipelined operation
- High-speed clock to data access 5/6 ns
- 3.3 V low operating power
  - Active = 250 mA (typical)
  - Standby = 10 µA (typical)
- Fully synchronous interface for ease of use
- Burst counters increment addresses internally
  - Shorten cycle times
  - Minimize bus noise
  - Supported in flow-through and pipelined modes
- Counter address read back via I/O lines
- Single chip enable
- Automatic power-down
- Commercial and industrial temperature ranges
- Compact package
  - 144-pin TQFP (20 × 20 × 1.4 mm)
  - 144-pin Pb-free TQFP (20 × 20 × 1.4 mm)
  - 172-ball BGA (15 × 15 × 0.51 mm (1.0 mm pitch))

Functional Description

The CY7C09569V and CY7C09579V are high-speed 3.3 V synchronous CMOS 16K and 32K × 36 dual-port static RAMs. Two ports are provided, permitting independent, simultaneous access for reads and writes to any location in memory. Registers on control, address, and data lines allow for minimal set-up and hold times. In pipelined output mode, data is registered for decreased cycle time. Clock to data valid t_{CD2} = 5 ns (pipelined). Flow-through mode can also be used to bypass the pipelined output register to eliminate access latency. In flow-through mode data will be available t_{CD1} = 12.5 ns after the address is clocked into the device. Pipelined output or flow-through mode is selected via the $\overline{FT}$/Pipe pin.

Each port contains a burst counter on the input address register. The internal write pulse width is independent of the external R/$\overline{W}$ LOW duration. The internal write pulse is self-timed to allow the shortest possible cycle times.

A HIGH on $\overline{CE}$ for one clock cycle will power down the internal circuitry to reduce the static power consumption. In the pipelined mode, one cycle is required with $\overline{CE}$ LOW to reactivate the outputs.

Counter Enable Inputs are provided to stall the operation of the address input and utilize the internal address generated by the internal counter for fast interleaved memory applications. A port's burst counter is loaded with the port's Address Strobe ($\overline{ADS}$). When the port's Count Enable ($\overline{CNTEN}$) is asserted, the address counter will increment on each LOW-to-HIGH transition of that port's clock signal. This will read/write one word from/into each successive address location until $\overline{CNTEN}$ is deasserted. The counter can address the entire memory array and will loop back to the start. Counter Reset ($\overline{CNTRST}$) is used to reset the burst counter.

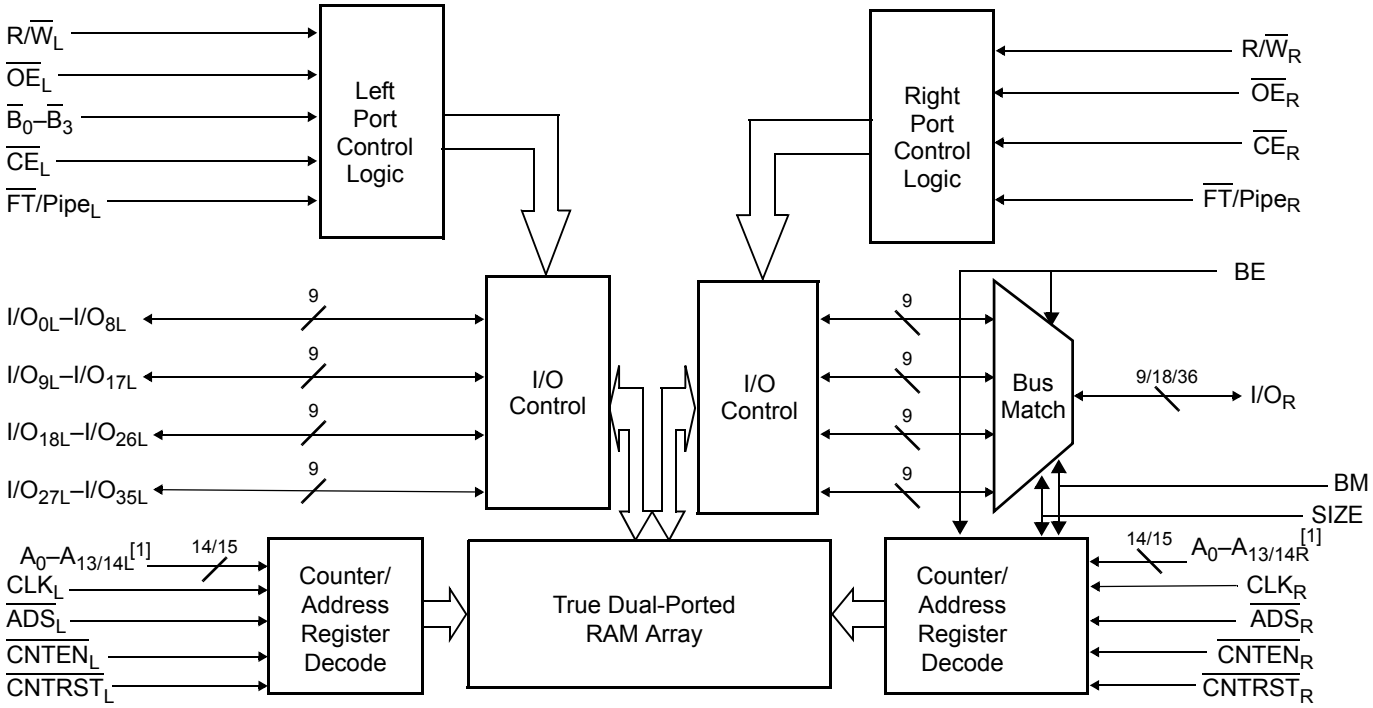
Parts are available in 144-pin Thin Quad Plastic Flatpack (TQFP), 144-pin Pb-free Thin Quad Plastic Flatpack (TQFP) and 172-ball Ball Grid Array (BGA) packages.

For a complete list of related documentation, click here.

Selection Guide

Description	CY7C09569V / CY7C09579V		Unit
	-100	-83	
f_{MAX2} (pipelined)	100	83	MHz
Maximum access time (clock to data, pipelined)	5	6	ns
Typical operating current I_{CC}	250	240	mA
Typical standby current for I_{SB1} (both ports TTL level)	30	25	mA
Typical standby current for I_{SB3} (both ports CMOS level)	10	10	µA

Logic Block Diagram

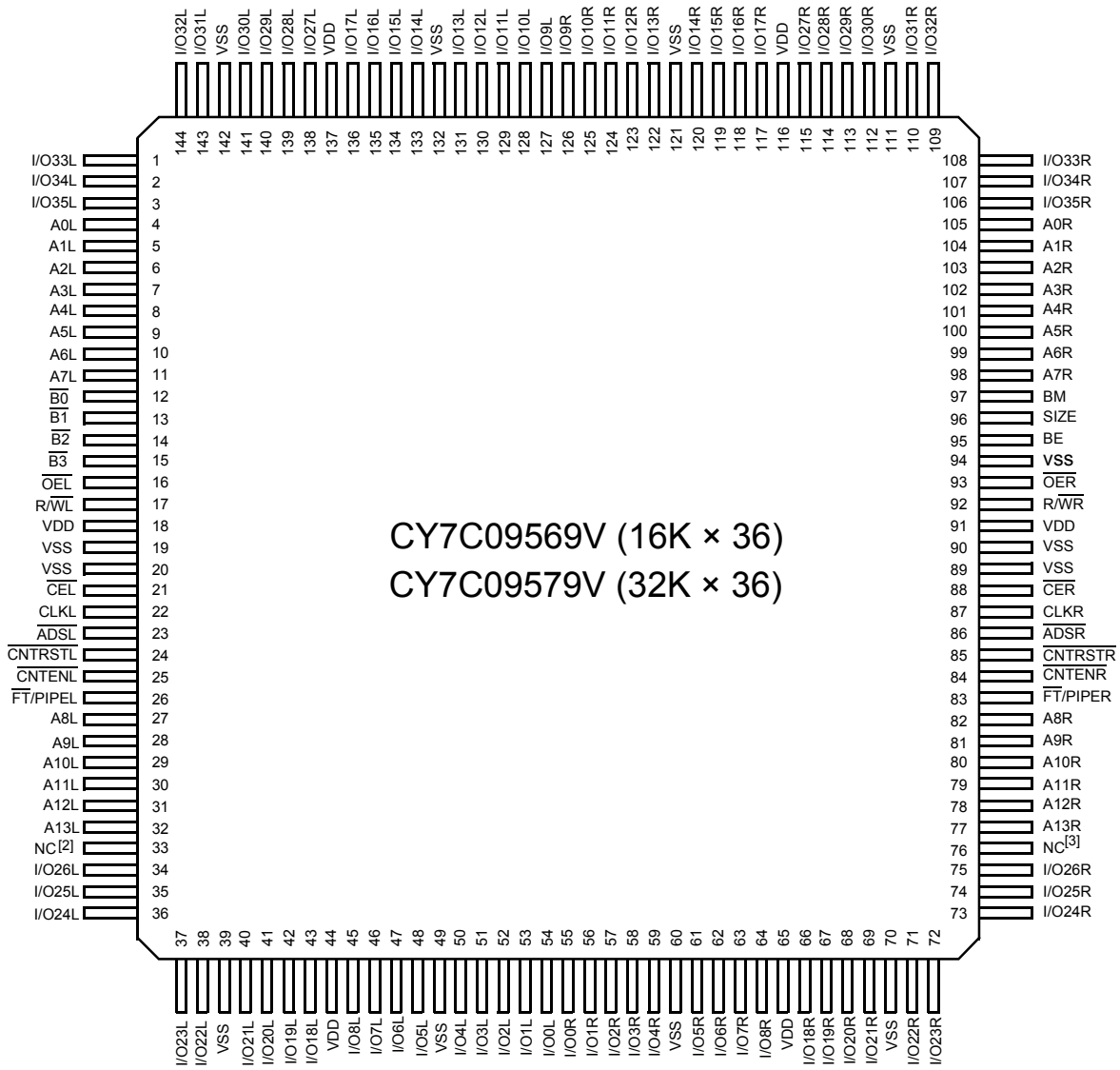


Note
1. A_0–A_{13} for 16K; A_0–A_{14} for 32K devices.

Contents

Pin Configurations

Figure 1. 144-pin TQFP (20 × 20 × 1.4 mm) pinout (Top View)



Notes
2. This pin is A14L for CY7C09579V.
3. This pin is A14R for CY7C09579V.

Pin Configurations *(continued)*

Figure 2. 172-ball BGA (15 × 15 × 1.25 mm) pinout (Top View)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
A	I/O32L	I/O30L	NC	VSS	I/O13L	VDD	I/O11L	I/O11R	VDD	I/O13R	VSS	NC	I/O30R	I/O32R
B	A0L	I/O33L	I/O29	I/O17L	I/O14L	I/O12L	I/O9L	I/O9R	I/O12R	I/O14R	I/O17R	I/O29R	I/O33R	A0R
C	NC	A1L	I/O31L	I/O27L	NC	I/O15L	I/O10L	I/O10R	I/O15R	NC	I/O27R	I/O31R	A1R	NC
D	A2L	A3L	I/O35L	I/O34L	I/O28L	I/O16L	VSS	VSS	I/O16R	I/O28R	I/O34R	I/O35R	A3R	A2R
E	A4L	A5L	NC	$\overline{B0L}$	NC	NC			NC	NC	BM	NC	A5R	A4R
F	VDD	A6L	A7L	$\overline{B1L}$	NC					NC	SIZE	A7R	A6R	VDD
G	$\overline{OEL}$	$\overline{B2L}$	$\overline{B3L}$	$\overline{CEL}$							$\overline{CER}$	VSS	BE	$\overline{OER}$
H	VSS	R/$\overline{WL}$	A8L	CLKL							CLKR	A8R	R/$\overline{WR}$	VSS
J	A9L	A10L	VSS	$\overline{ADSL}$	NC					NC	$\overline{ADSR}$	VSS	A10R	A9R
K	A11L	A12L	NC	$\overline{CNTRSTL}$	NC	NC			NC	NC	$\overline{CNTRSTR}$	NC	A12R	A11R
L	$\overline{FT/PIPEL}$	A13L	$\overline{CNTENL}$	I/O26L	I/O25L	I/O19L	VSS	VSS	I/O19R	I/O25R	I/O26R	$\overline{CNTENR}$	A13R	$\overline{FT/PIPER}$
M	NC	NC[4]	I/O22L	I/O18L	NC	I/O7L	I/O2L	I/O2R	I/O7R	NC	I/O18R	I/O22R	NC[5]	NC
N	I/O24L	I/O20L	I/O8L	I/O6L	I/O5L	I/O3L	I/O0L	I/O0R	I/O3R	I/O5R	I/O6R	I/O8R	I/O20R	I/O24R
P	I/O23L	I/O21L	NC	VSS	I/O4L	VDD	I/O1L	I/O1R	VDD	I/O4R	VSS	NC	I/O21R	I/O23R

Notes
4. This pin is A14L for CY7C09579V.
5. This pin is A14R for CY7C09579V.

Pin Definitions

Left Port	Right Port	Description
A_{0L}–$A_{13/14L}$	A_{0R}–$A_{13/14R}$	Address Inputs (A_0–A_{13} for 16K, A_0–A_{14} for 32K devices).
$\overline{ADS}_L$	$\overline{ADS}_R$	Address Strobe Input. Used as an address qualifier. This signal should be asserted LOW to assert the part using the externally supplied address on Address Pins. To load this address into the Burst Address Counter both ADS and CNTEN have to be LOW. ADS is disabled if CNTRST is asserted LOW.
$\overline{CE}_L$	$\overline{CE}_R$	Chip Enable Input.
CLK_L	CLK_R	Clock Signal. This input can be free-running or strobed. Maximum clock input rate is f_{MAX}.
$\overline{CNTEN}_L$	$\overline{CNTEN}_R$	Counter Enable Input. Asserting this signal LOW increments the burst address counter of its respective port on each rising edge of CLK. CNTEN is disabled if CNTRST is asserted LOW.
$\overline{CNTRST}_L$	$\overline{CNTRST}_R$	Counter Reset Input. Asserting this signal LOW resets the burst address counter of its respective port to zero. CNTRST is not disabled by asserting ADS or CNTEN.
I/O_{0L}–I/O_{35L}	I/O_{0R}–I/O_{35R}	Data Bus Input/Output
$\overline{OE}_L$	$\overline{OE}_R$	Output Enable Input. This signal must be asserted LOW to enable the I/O data pins during read operations.
$R/\overline{W}_L$	$R/\overline{W}_R$	Read/Write Enable Input. This signal is asserted LOW to write to the dual port memory array. For read operations, assert this pin HIGH.
$\overline{FT}/PIPE_L$	$\overline{FT}/PIPE_R$	Flow-Through/Pipelined Select Input. For flow-through mode operation, assert this pin LOW. For pipelined mode operation, assert this pin HIGH.
$\overline{B}_{0L}$–$\overline{B}_{3L}$	–	Byte Select Inputs. Asserting these signals enable read and write operations to the corresponding bytes of the memory array.
–	BM, SIZE	Select Pins for Bus Matching. See Bus Matching for details.
–	BE	Big Endian Pin. See Bus Matching for details.
V_{SS}		Ground Input.
V_{DD}		Power Input.

Maximum Ratings

Exceeding maximum ratings[6] may shorten the useful life of the device. User guidelines are not tested.

Storage temperature ..... –65 °C to +150 °C

Ambient temperature with power applied ..... –55 °C to +125 °C

Supply voltage to ground potential .....–0.5 V to +4.6 V

DC voltage applied to outputs in High Z state .....–0.5 V to V_{DD} + 0.5 V

DC input voltage[7] .....–0.5 V to V_{DD} + 0.5 V

Output current into outputs (LOW) ..... 20 mA

Static discharge voltage ..... > 2001 V

Latch-up current ..... > 200 mA

Operating Range

Range	Ambient Temperature	V_{DD}
Commercial	0 °C to +70 °C	3.3 V ± 165 mV

Electrical Characteristics

Over the Operating Range

Parameter	Description	CY7C09569V / CY7C09579V						Unit
		-100			-83			
		Min	Typ	Max	Min	Typ	Max	
V_{OH}	Output HIGH Voltage (V_{DD} = Min., I_{OH} = –4.0 mA)	2.4	–	–	2.4	–	–	V
V_{OL}	Output LOW Voltage (V_{DD} = Min., I_{OL}= +4.0 mA)	–	–	0.4	–	–	0.4	V
V_{IH}	Input HIGH Voltage	2.0	–	–	2.0	–	–	V
V_{IL}	Input LOW Voltage	–	–	0.8	–	–	0.8	V
I_{OZ}	Output Leakage Current	–10	–	10	–10	–	10	µA
I_{CC}	Operating Current (V_{DD} = Max., I_{OUT} = 0 mA) Outputs Disabled	–	250	385	–	240	360	mA
I_{SB1}	Standby Current (Both Ports TTL Level) $\overline{CE}_L$ & $\overline{CE}_R \geq V_{IH}$, f = f_{MAX}	–	30	75	–	25	70	mA
I_{SB2}	Standby Current (One Port TTL Level) $\overline{CE}_L$ | $\overline{CE}_R \geq V_{IH}$, f = f_{MAX}	–	170	220	–	160	210	mA
I_{SB3}	Standby Current (Both Ports CMOS Level) $\overline{CE}_L$ & $\overline{CE}_R \geq V_{DD}$ – 0.2 V, f = 0	–	0.01	1	–	0.01	1	mA
I_{SB4}	Standby Current (One Port CMOS Level) $\overline{CE}_L$ | $\overline{CE}_R \geq V_{IH}$, f = f_{MAX}	–	150	200	–	140	190	mA

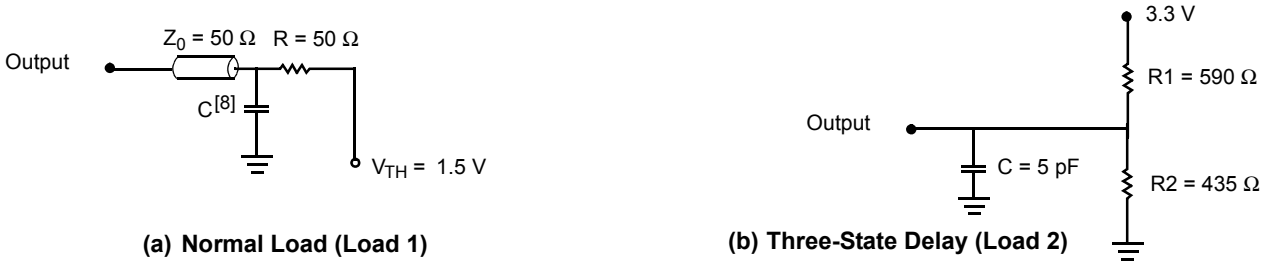
Notes
6. The voltage on any input or I/O pin can not exceed the power pin during power-up.
7. Pulse width < 20 ns.

Capacitance

Parameter	Description	Test Conditions	Max	Unit
C_{IN}	Input capacitance	T_A = 25 °C, f = 1 MHz, V_{DD} = 3.3 V	10	pF
C_{OUT}	Output capacitance		10	pF

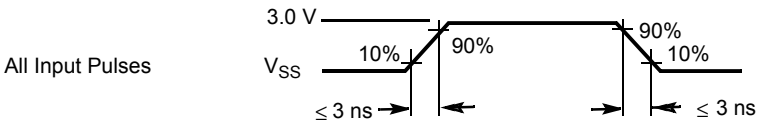
AC Test Load and Waveforms

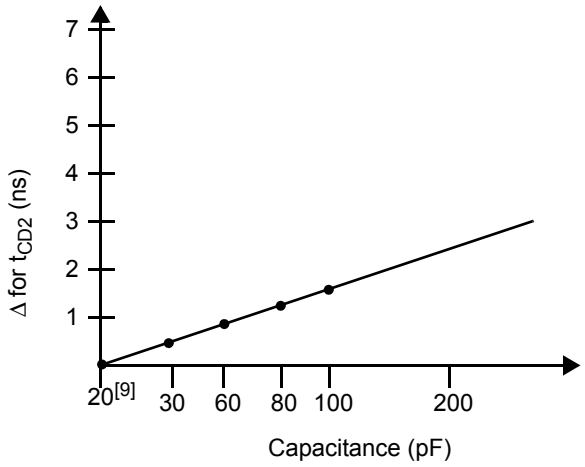
Figure 3. AC Test Load and Waveforms



(a) Normal Load (Load 1)

(b) Three-State Delay (Load 2)





(b) Load Derating Curve

Notes
8. External AC Test Load Capacitance = 10 pF.
9. (Internal I/O pad Capacitance = 10 pF + AC Test Load.

Switching Characteristics

Over the Operating Range

Parameter	Description	CY7C09569V/CY7C09579V				Unit
		-100		-83		
		Min	Max	Min	Max	
f_{MAX1}	f_{Max} Flow-Through	–	67	–	45	MHz
f_{MAX2}	f_{Max} Pipelined	–	100	–	83	MHz
t_{CYC1}	Clock Cycle Time – Flow-Through	15	–	22	–	ns
t_{CYC2}	Clock Cycle Time – Pipelined	10	–	12	–	ns
t_{CH1}	Clock HIGH Time – Flow-Through	6.5	–	7.5	–	ns
t_{CL1}	Clock LOW Time – Flow-Through	6.5	–	7.5	–	ns
t_{CH2}	Clock HIGH Time – Pipelined	4	–	5	–	ns
t_{CL2}	Clock LOW Time – Pipelined	4	–	5	–	ns
t_R	Clock Rise Time	–	3	–	3	ns
t_F	Clock Fall Time	–	3	–	3	ns
t_{SA}	Address Set-Up Time	3.5	–	4	–	ns
t_{HA}	Address Hold Time	0.5	–	0.5	–	ns
t_{SB}	Byte Select Set-Up Time	3.5	–	4	–	ns
t_{HB}	Byte Select Hold Time	0.5	–	0.5	–	ns
t_{SC}	Chip Enable Set-Up Time	3.5	–	4	–	ns
t_{HC}	Chip Enable Hold Time	0.5	–	0.5	–	ns
t_{SW}	R/$\overline{W}$ Set-Up Time	3.5	–	4	–	ns
t_{HW}	R/$\overline{W}$ Hold Time	0.5	–	0.5	–	ns
t_{SD}	Input Data Set-Up Time	3.5	–	4	–	ns
t_{HD}	Input Data Hold Time	0.5	–	0.5	–	ns
t_{SAD}	$\overline{ADS}$ Set-Up Time	3.5	–	4	–	ns
t_{HAD}	$\overline{ADS}$ Hold Time	0.5	–	0.5	–	ns
t_{SCN}	$\overline{CNTEN}$ Set-Up Time	3.5	–	4	–	ns
t_{HCN}	$\overline{CNTEN}$ Hold Time	0.5	–	0.5	–	ns
t_{SRST}	$\overline{CNTRST}$ Set-Up Time	3.5	–	4	–	ns
t_{HRST}	$\overline{CNTRST}$ Hold Time	0.5	–	0.5	–	ns

Switching Characteristics *(continued)*

Over the Operating Range

Parameter	Description	CY7C09569V/CY7C09579V				Unit
		-100		-83		
		Min	Max	Min	Max	
t_{OE}	Output Enable to Data Valid	–	8	–	9	ns
t_{OLZ}[10, 11]	$\overline{OE}$ to Low Z	2	–	2	–	ns
t_{OHZ}[10, 11]	$\overline{OE}$ to High Z	1	7	1	7	ns
t_{CD1}	Clock to Data Valid – Flow-Through	–	12.5	–	18	ns
t_{CD2}	Clock to Data Valid – Pipelined	–	5	–	6	ns
t_{CA1}	Clock to Counter Address Valid – Flow-Through	–	12.5	–	18	ns
t_{CA2}	Clock to Counter Address Valid – Pipelined	–	9	–	10	ns
t_{DC}	Data Output Hold After Clock HIGH	2	–	2	–	ns
t_{CKHZ}[10, 11]	Clock HIGH to Output High Z	2	6	2	7	ns
t_{CKLZ}[10, 11]	Clock HIGH to Output Low Z	2	–	2	–	ns
Port to Port Delays						
t_{CWDD}	Write Port Clock HIGH to Read Data Delay	–	30	–	35	ns
t_{CCS}	Clock to Clock Set-Up Time	–	9	–	10	ns

Notes
10. This parameter is guaranteed by design, but it is not production tested.
11. Test conditions used are Load 2.

Switching Waveforms

Figure 4. Read Cycle for Flow-Through Output ($\overline{FT}$/PIPE = V_{IL}) [12, 13, 14, 15]

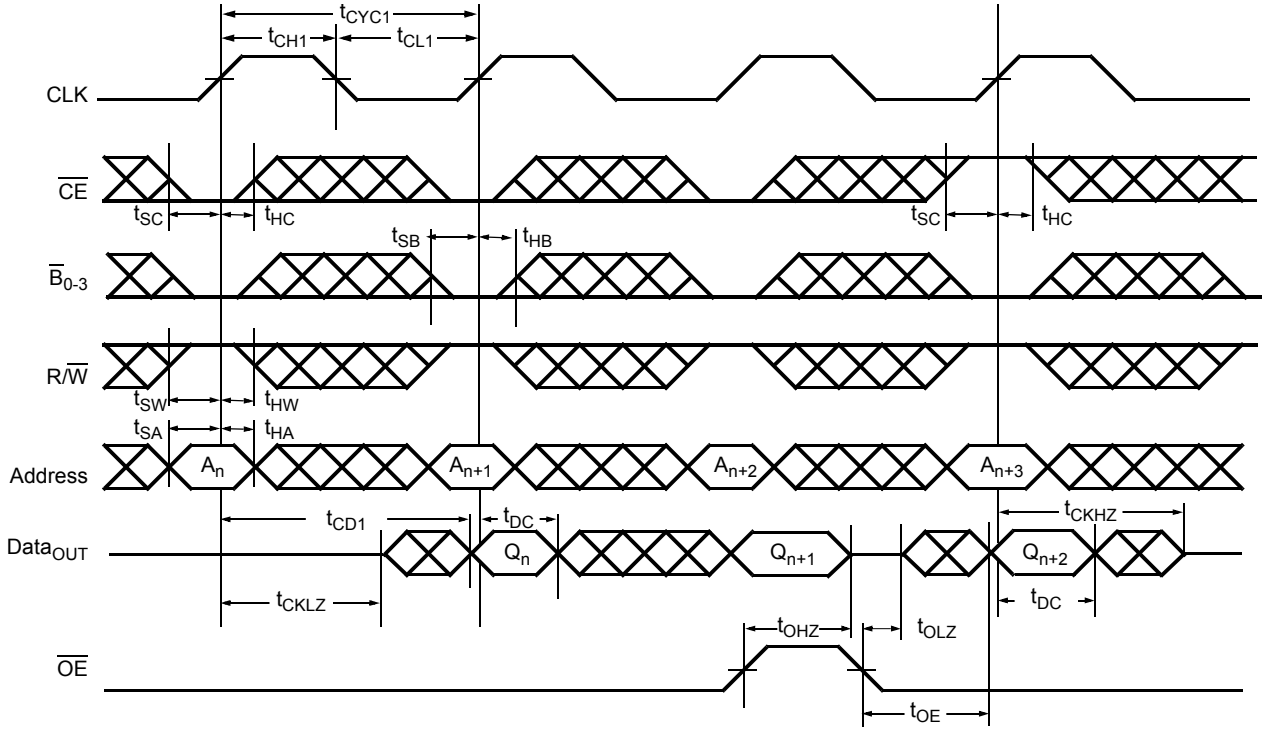
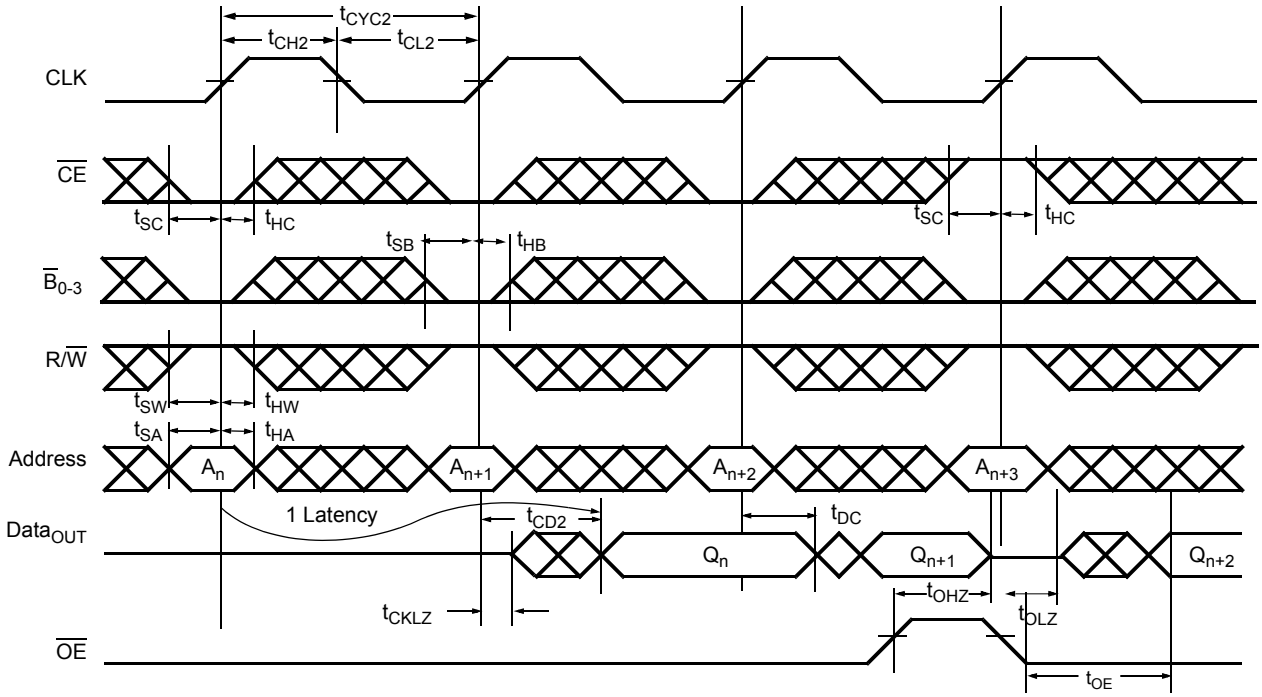


Figure 5. Read Cycle for Pipelined Operation ($\overline{FT}$/PIPE = V_{IH}) [12, 13, 14, 15]



Notes
12. $\overline{OE}$ is asynchronously controlled; all other inputs are synchronous to the rising clock edge.
13. $\overline{ADS}$ = V_{IL}, $\overline{CNTEN}$ = V_{IL} and $\overline{CNTRST}$ = V_{IH}.
14. The output is disabled (high-impedance state) by $\overline{CE}$=V_{IH} following the next rising edge of the clock.
15. Addresses do not have to be accessed sequentially since $\overline{ADS}$ = V_{IL} constantly loads the address on the rising edge of the CLK. Numbers are for reference only.

Switching Waveforms *(continued)*

Figure 6. Bus Match Read Cycle for Flow-Through Output ($\overline{FT}$/PIPE = V_{IL}) [16, 17, 18, 19, 20]

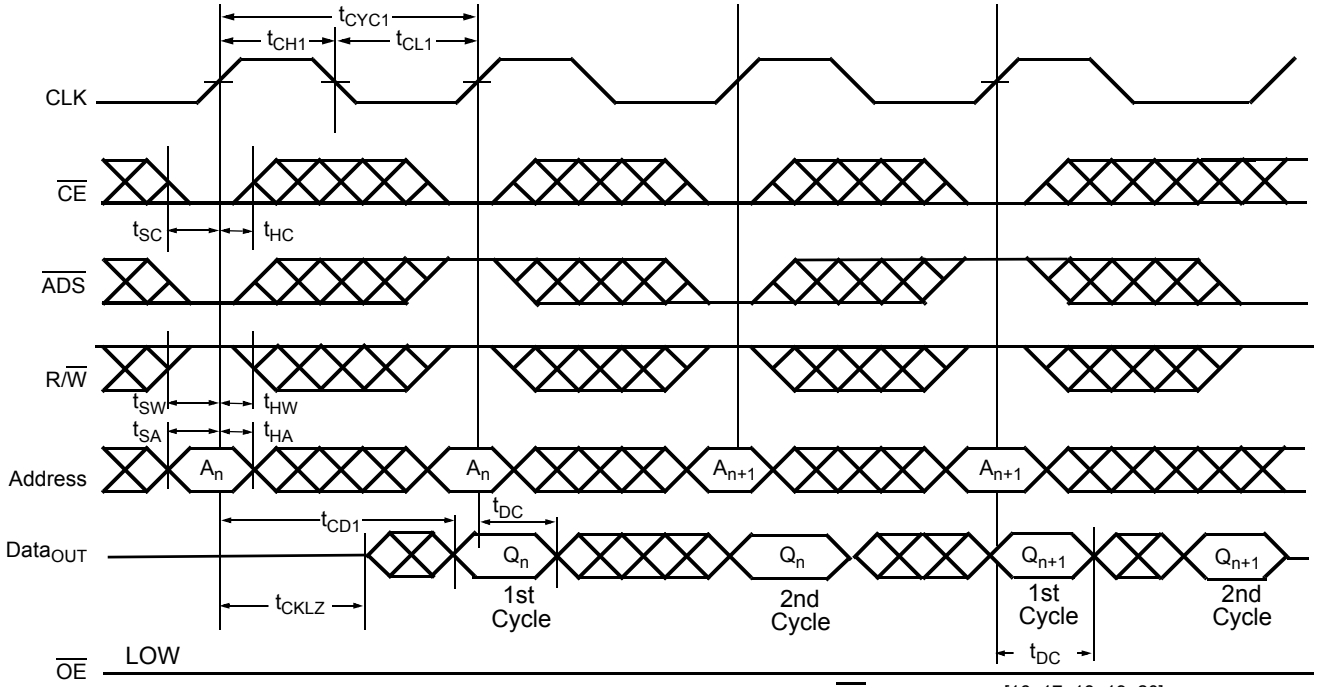
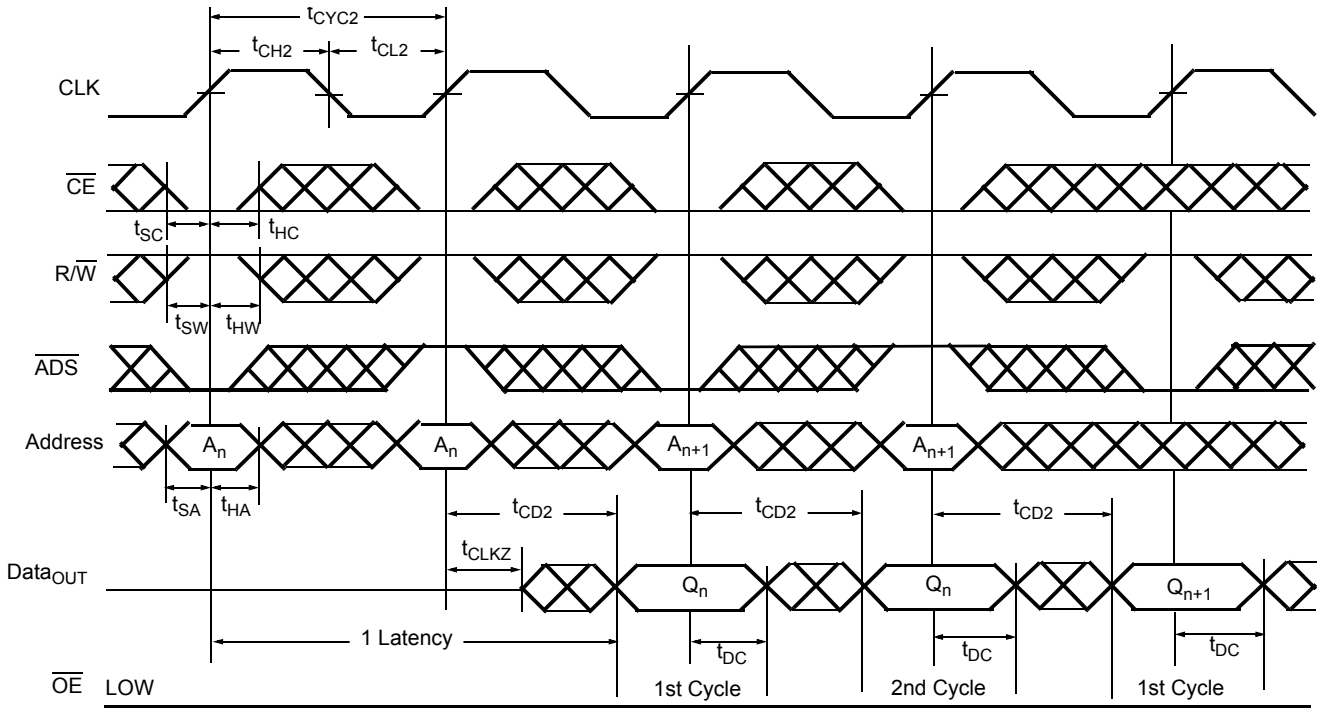


Figure 7. Bus Match Read Cycle for Pipelined Operation ($\overline{FT}$/PIPE = V_{IH}) [16, 17, 18, 19, 20]



Notes

16. $\overline{OE}$ is asynchronously controlled; all other inputs are synchronous to the rising clock edge.
17. The output is disabled (high-impedance state) by $\overline{CE}$=V_{IH} following the next rising edge of the clock.
18. Timing shown is for x18 bus matching; x9 bus matching is similar with 4 cycles between address inputs.
19. See table "Right Port Operation" for data output on first and subsequent cycles.
20. $\overline{CNTEN}$ = V_{IL}. In x9 and x18 Bus Matching Burst Mode operations (Write or Read), $\overline{ADS}$ can toggle on the rising edge of every clock cycle or it can be at V_{IH} level all the time except when loading the initial external address (i.e. $\overline{ADS}$ = V_{IL} only required when reading or writing the first Byte or Word).

Switching Waveforms *(continued)*

Figure 8. Bank Select Pipelined Read [21, 22]

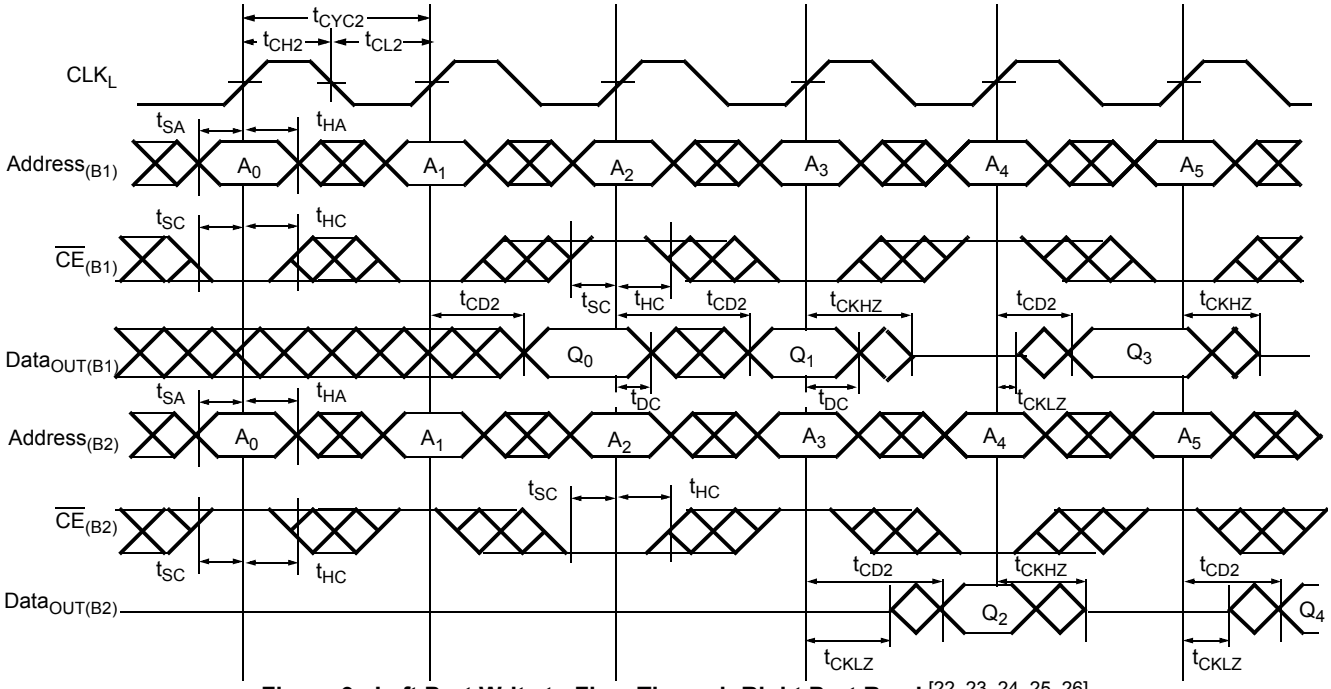
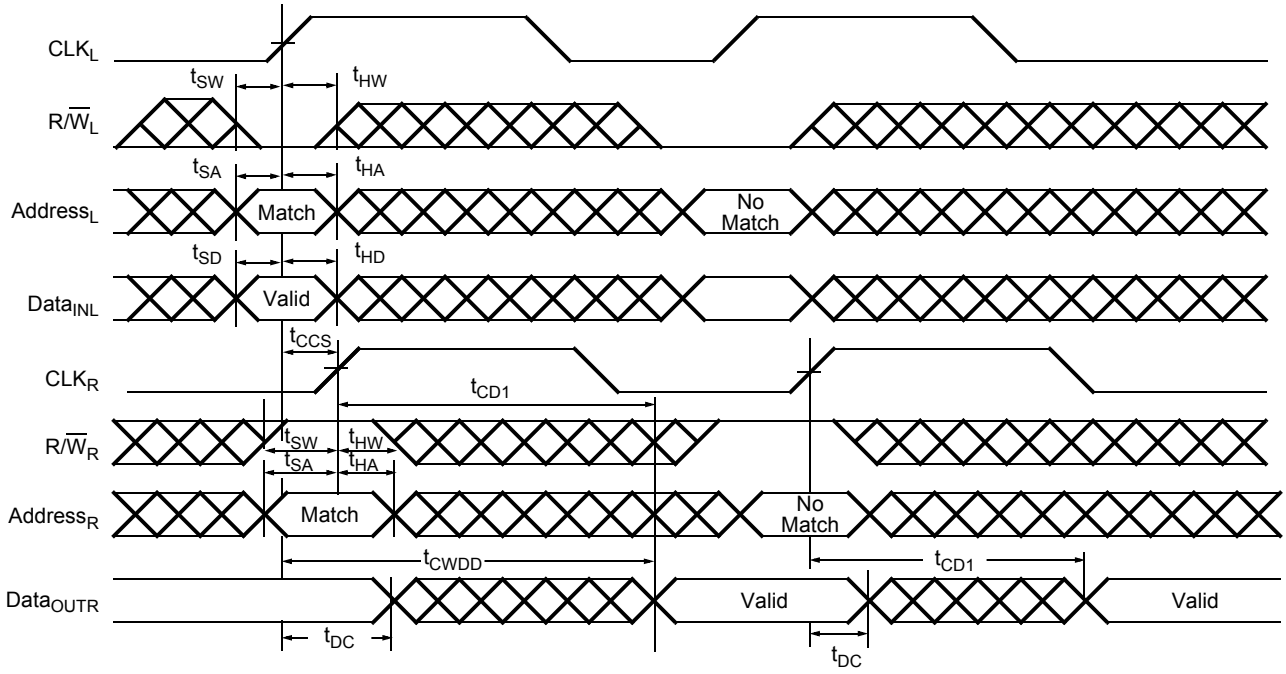


Figure 9. Left Port Write to Flow-Through Right Port Read [22, 23, 24, 25, 26]

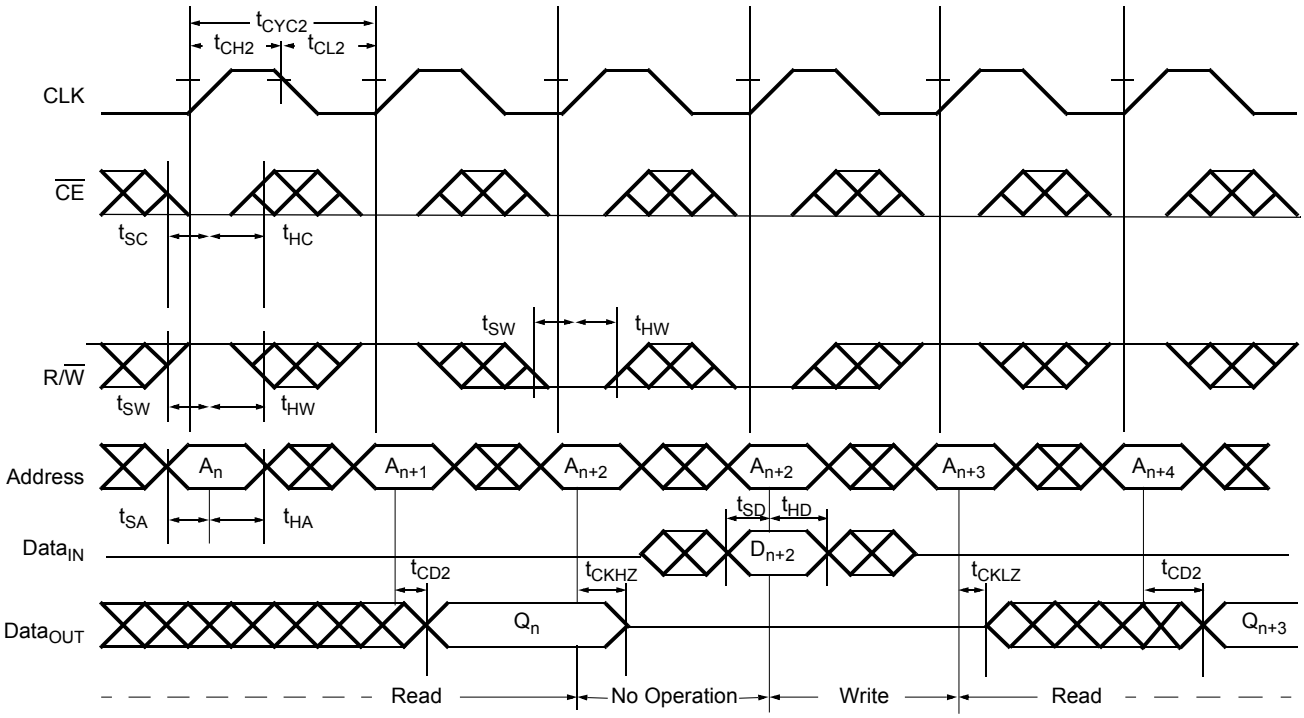


Notes

21. In this depth expansion example, B1 represents Bank #1 and B2 is Bank #2; Each Bank consists of one Cypress dual-port device from this data sheet. $\underline{\text{ADDRESS}}_{(B1)} = \underline{\text{ADDRESS}}_{(B2)}$.
22. $\overline{B0} = \overline{B1} = \overline{B2} = \overline{B3} = BM = SIZE = \overline{ADS} = \overline{CNTEN} = V_{IL}$, $\overline{CNTRST} = V_{IH}$.
23. The same waveforms apply for a right port write to flow-through left port read.
24. $\overline{CE} = \overline{B0} = \overline{B1} = \overline{B2} = \overline{B3} = \overline{ADS} = \overline{CNTEN} = V_{IL}$; $\overline{CNTRST} = V_{IH}$.
25. $\overline{OE} = V_{IL}$ for the right port, which is being read from. $\overline{OE} = V_{IH}$ for the left port, which is being written to.
26. If $t_{CCS} \le$ maximum specified, then data from right port READ is not valid until the maximum specified for t_{CWDD}. If $t_{CCS} >$ maximum specified, then data is not valid until $t_{CCS} + t_{CD1}$ (t_{CWDD} does not apply in this case).

Switching Waveforms *(continued)*

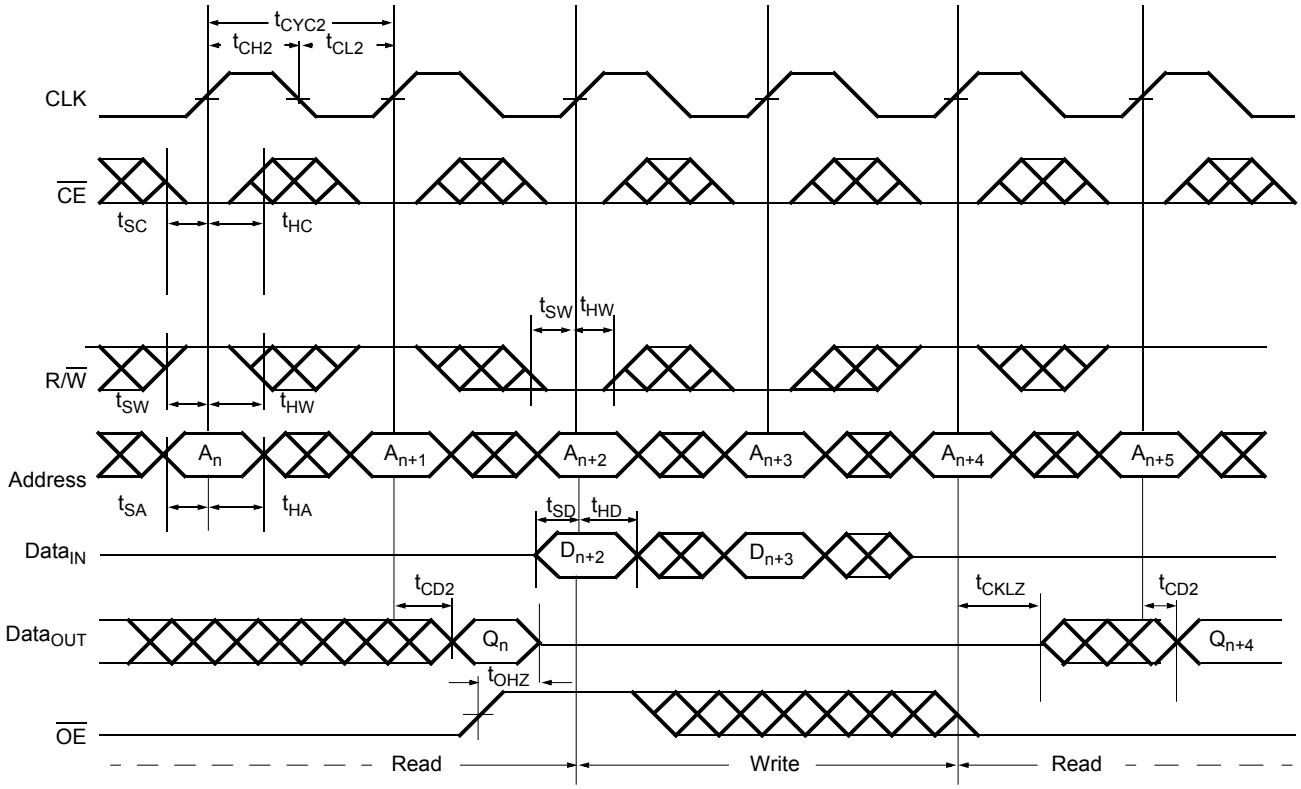
Figure 10. Pipelined Read-to-Write-to-Read ($\overline{OE}$ = V_{IL}) [27, 28, 29, 30]



Notes
27. Addresses do not have to be accessed sequentially since $\overline{ADS}$ = V_{IL} constantly loads the address on the rising edge of the CLK. Numbers are for reference only.
28. Output state (HIGH, LOW, or High-Impedance) is determined by the previous cycle control signals.
29. $\overline{CE}$ = ADS = $\overline{CNTEN}$ = V_{IL}; $\overline{CNTRST}$ = V_{IH}.
30. During “No Operation,” data in memory at the selected address may be corrupted and should be rewritten to ensure data integrity.

Switching Waveforms *(continued)*

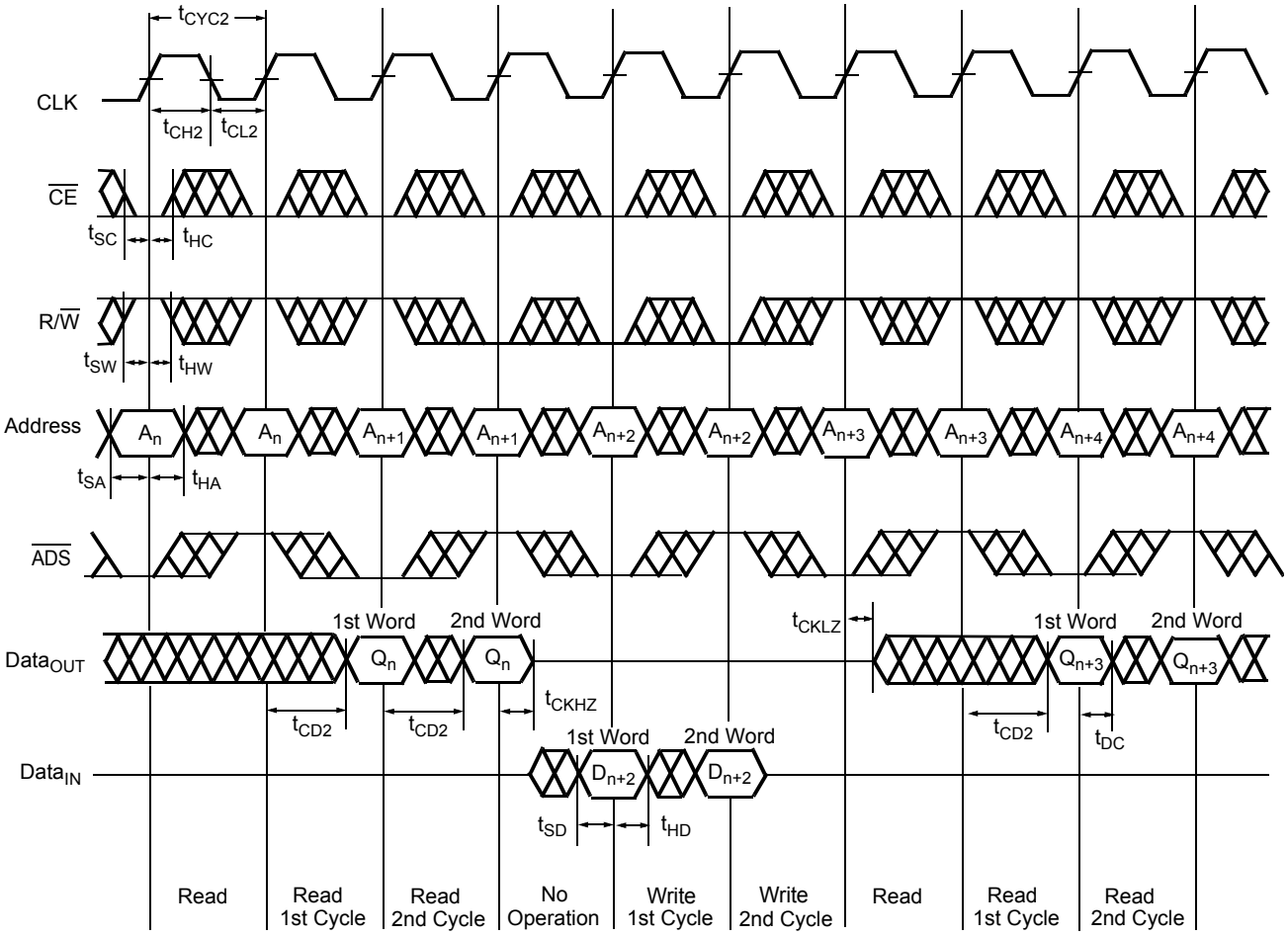
Figure 11. Pipelined Read-to-Write-to-Read ($\overline{OE}$ Controlled) [31, 32, 33, 34]



Notes
31. Test conditions used are Load 2.
32. Output state (HIGH, LOW, or High-Impedance) is determined by the previous cycle control signals.
33. $\overline{CE}$ = $\overline{ADS}$ = $\overline{CNTEN}$ = V_{IL}; $\overline{CNTRST}$ = V_{IH}.
34. During “No Operation,” data in memory at the selected address may be corrupted and should be rewritten to ensure data integrity.

Switching Waveforms *(continued)*

Figure 12. Bus Match Pipelined Read-to-Write-to-Read ($\overline{OE}$ = V_{IL}) [35, 36, 37, 38, 39, 40, 41]



Notes

35. Test conditions used are Load 2.
36. Timing shown is for x18 bus matching; x9 bus matching is similar with 4 cycles between address inputs.
37. See table “Right Port Operation“ for data output on first and subsequent cycles.
38. $\overline{CNTEN}$ = V_{IL}. In x9 and x18 Bus Matching Burst Mode operations (Write or Read), $\overline{ADS}$ can toggle on the rising edge of every clock cycle or it can be at V_{IH} level all the time except when loading the initial external address (i.e. $\overline{ADS}$ = V_{IL} only required when reading or writing the first Byte or Word).
39. $\overline{CE}$ = $\overline{ADS}$ = $\overline{CNTEN}$ = V_{IL}; $\overline{CNTRST}$ = V_{IH}.
40. During “No Operation,” data in memory at the selected address may be corrupted and should be rewritten to ensure data integrity.
41. BM, SIZE, and BE must be reconfigured 1 cycle before operation is guaranteed. BM, SIZE, and BE should remain static for any particular port configuration.

Switching Waveforms *(continued)*

Figure 13. Flow-Through Read-to-Write-to-Read ($\overline{OE}$ = V_{IL}) [42, 43, 44, 45, 46, 47]

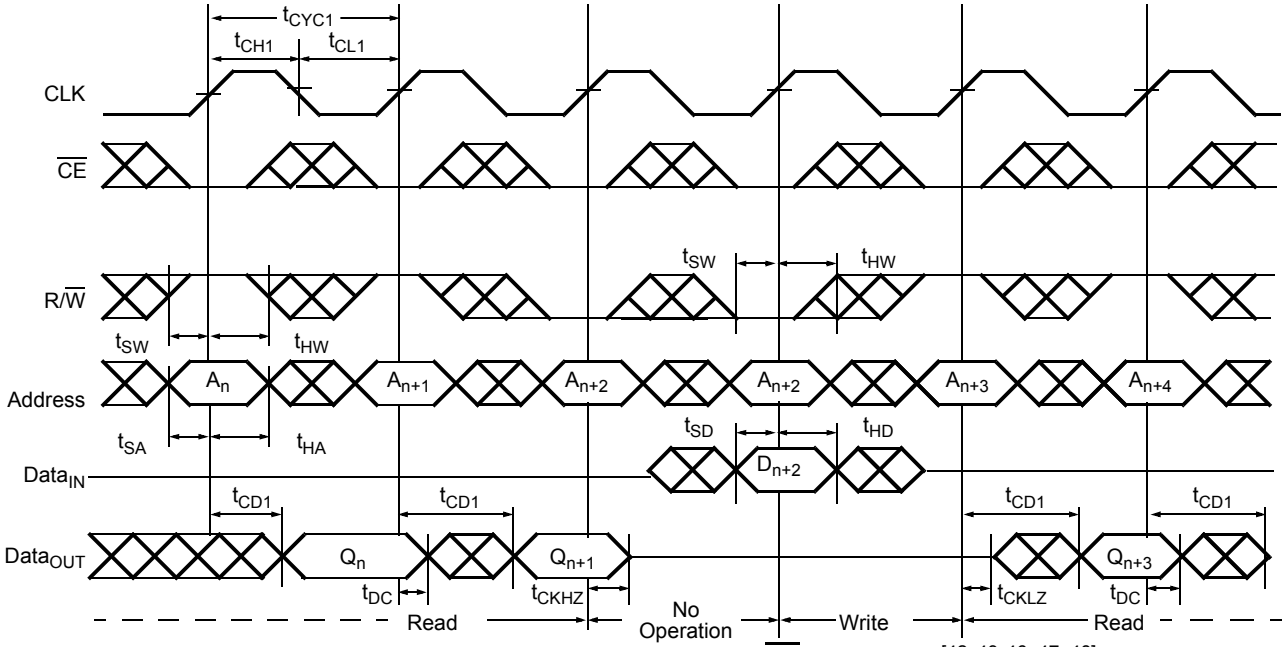
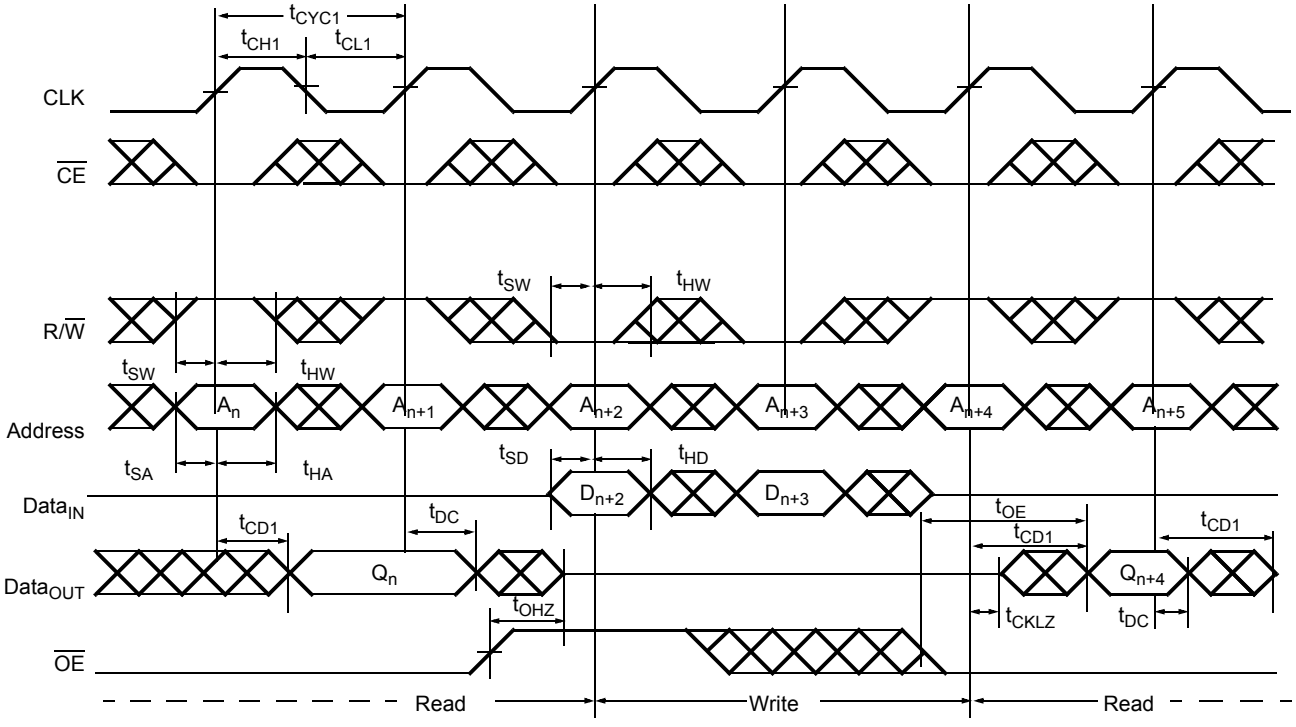


Figure 14. Flow-Through Read-to-Write-to-Read ($\overline{OE}$ Controlled) [42, 43, 46, 47, 48]

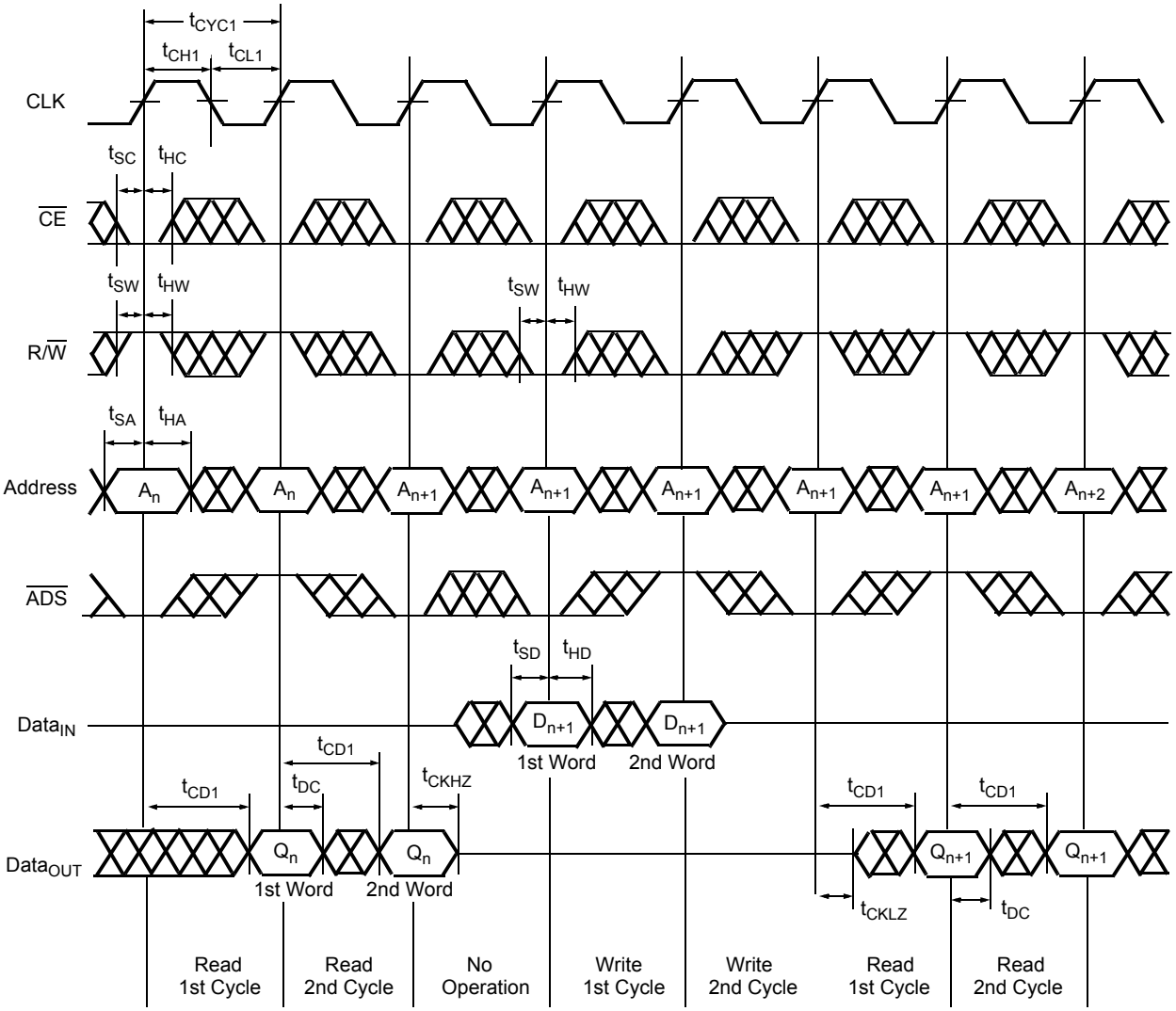


Notes

42. $\overline{ADS}$ = V_{IL}, $\overline{CNTEN}$ = V_{IL} and $\overline{CNTRST}$ = V_{IH}.
43. Addresses do not have to be accessed sequentially since $\overline{ADS}$ = V_{IL} constantly loads the address on the rising edge of the CLK. Numbers are for reference only.
44. Timing shown is for x18 bus matching; x9 bus matching is similar with 4 cycles between address inputs.
45. See table "Right Port Operation" for data output on first and subsequent cycles.
46. $\overline{CE}$ = $\overline{ADS}$ = $\overline{CNTEN}$ = V_{IL}; $\overline{CNTRST}$ = V_{IH}.
47. During "No Operation," data in memory at the selected address may be corrupted and should be rewritten to ensure data integrity.
48. Output state (HIGH, LOW, or High-Impedance) is determined by the previous cycle control signals.

Switching Waveforms *(continued)*

Figure 15. Bus Match Flow-Through Read-to-Write-to-Read ($\overline{OE}$ = V_{IL}) [49, 50, 51, 52, 53, 54, 55]



Notes

49. Test conditions used are Load 2.
50. Timing shown is for x 18 bus matching; x 9 bus matching is similar with 4 cycles between address inputs.
51. See table “Right Port Operation“ for data output on first and subsequent cycles.
52. $\overline{CNTEN}$ = V_{IL}. In x9 and x18 Bus Matching Burst Mode operations (Write or Read), $\overline{ADS}$ can toggle on the rising edge of every clock cycle or it can be at V_{IH} level all the time except when loading the initial external address (i.e. $\overline{ADS}$ = V_{IL} only required when reading or writing the first Byte or Word).
53. $\overline{CE}$ = $\overline{ADS}$ = $\overline{CNTEN}$ = V_{IL}; $\overline{CNTRST}$ = V_{IH}.
54. During “No Operation,” data in memory at the selected address may be corrupted and should be rewritten to ensure data integrity.
55. BM, SIZE, and BE must be reconfigured 1 cycle before operation is guaranteed. BM, SIZE, and BE should remain static for any particular port configuration.

Switching Waveforms *(continued)*

Figure 16. Pipelined Read with Address Counter Advance [56]

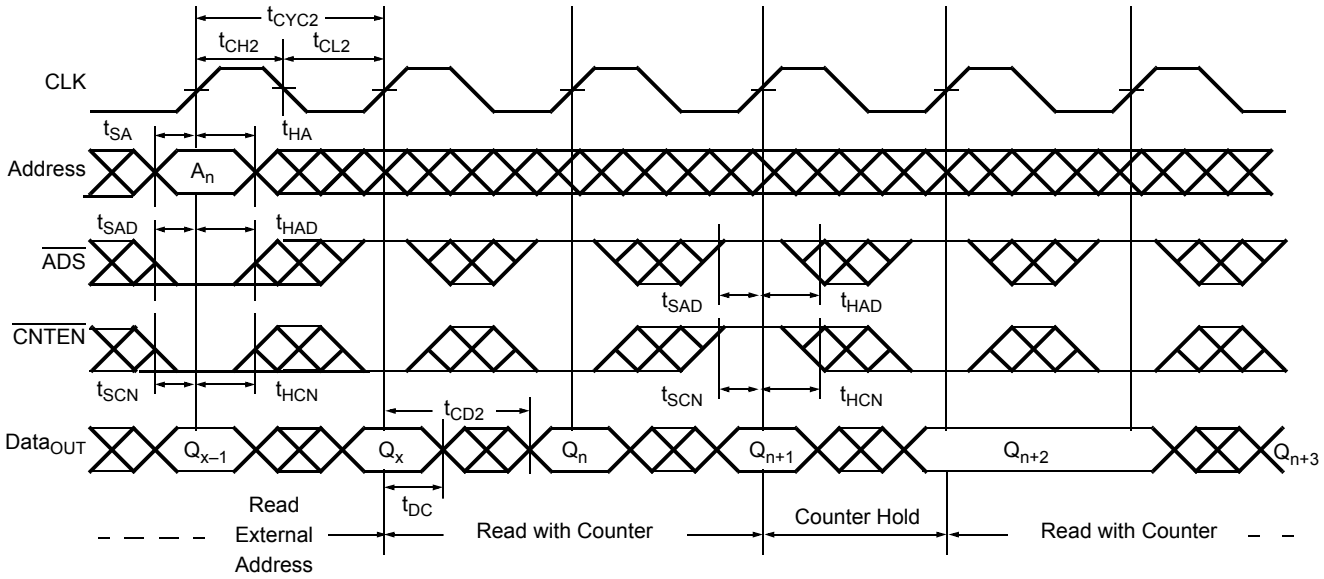
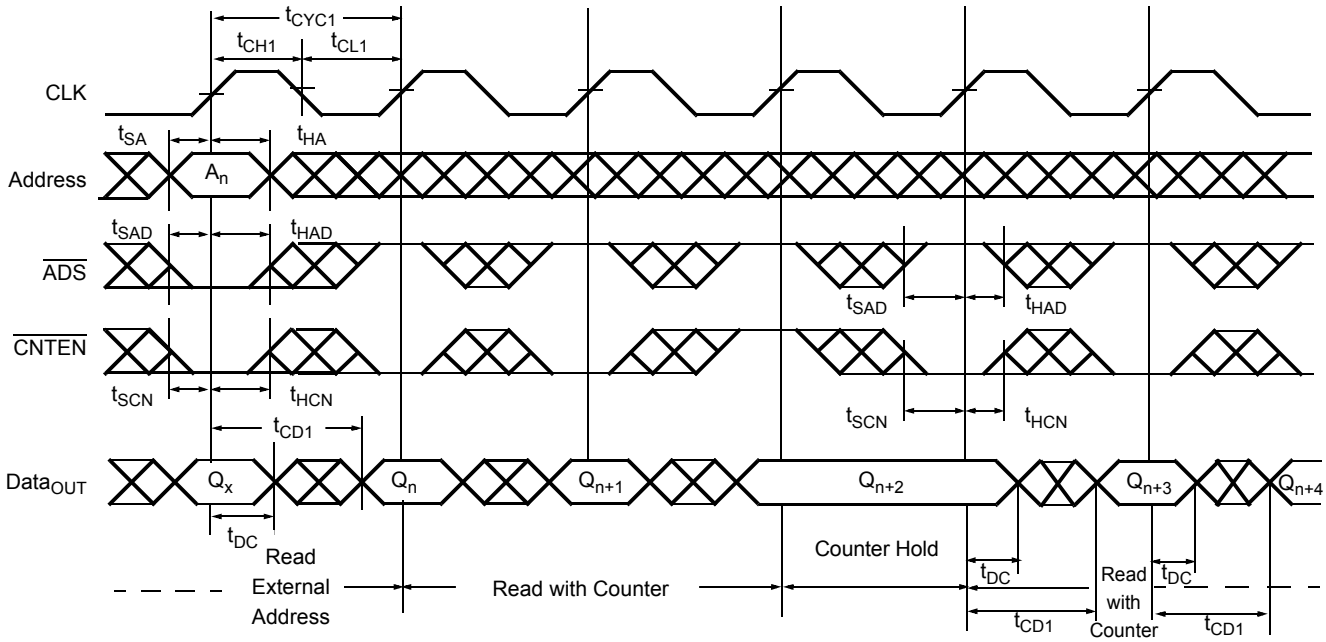


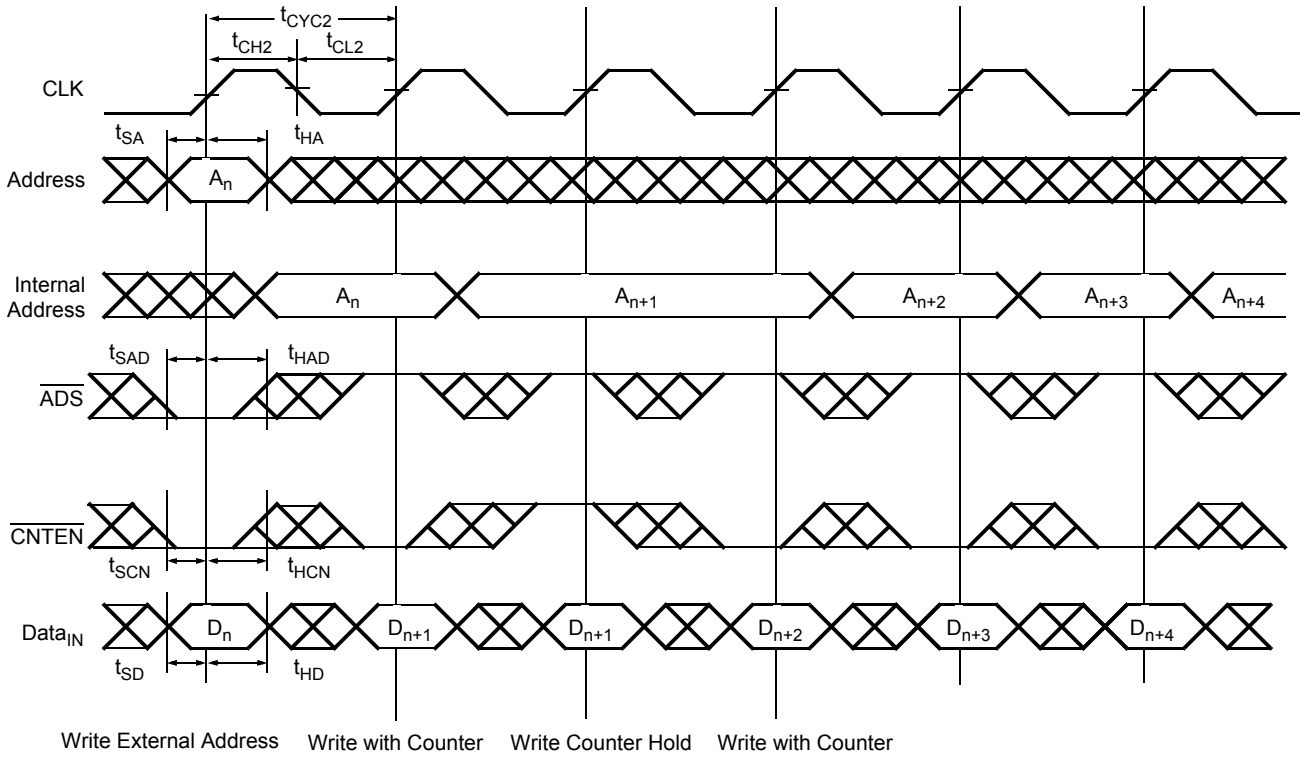
Figure 17. Flow-Through Read with Address Counter Advance [56]



Note
56. $\overline{CE}$ = $\overline{OE}$ = V_{IL}; R/$\overline{W}$ = $\overline{CNTRST}$ = V_{IH}.

Switching Waveforms *(continued)*

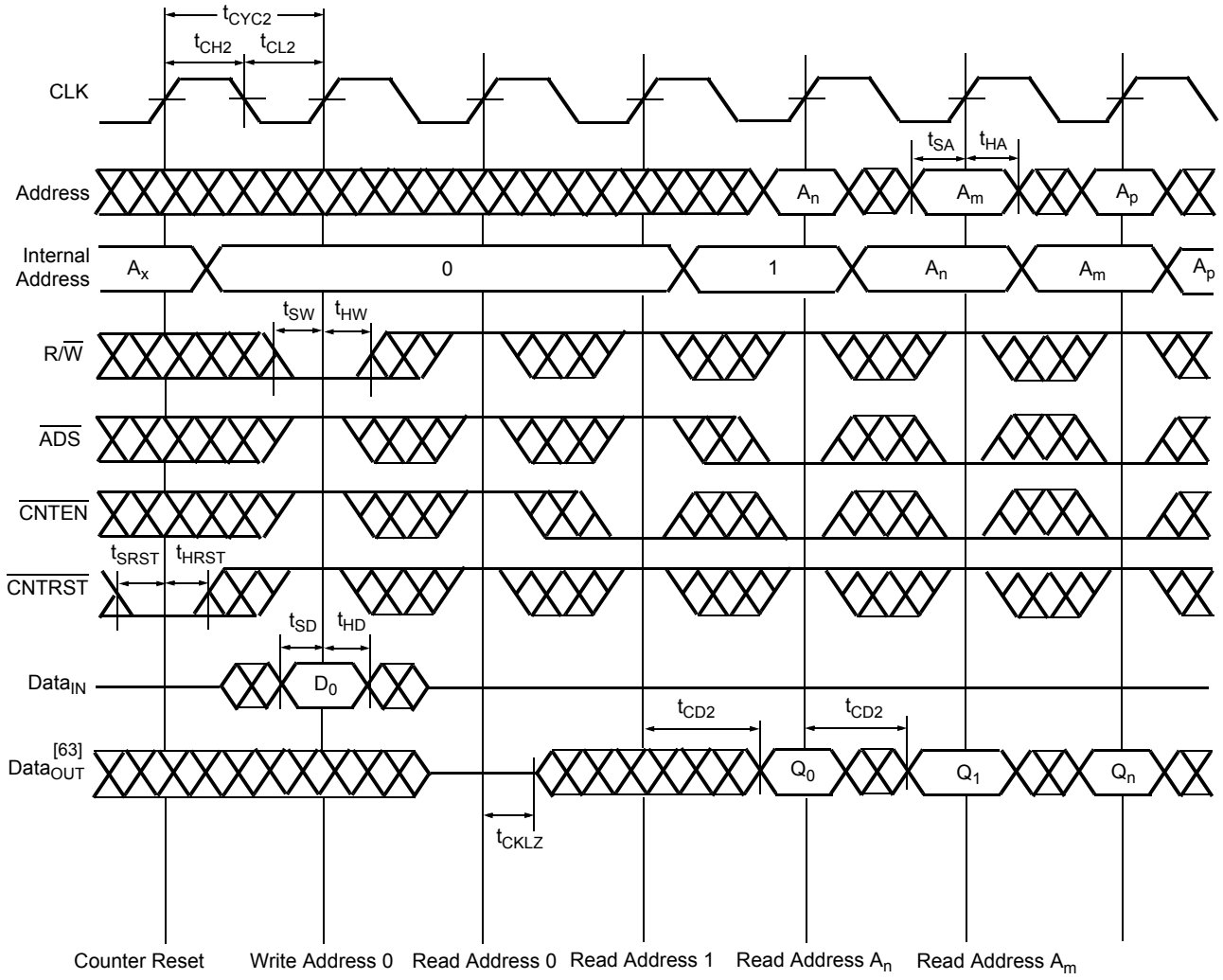
Figure 18. Write with Address Counter Advance (Flow-Through or Pipelined Outputs) [57, 58]



Notes
57. $\overline{CE}$= $\overline{B0}$ = $\overline{B1}$ = $\overline{B2}$ = $\overline{B3}$ = R/$\overline{W}$ = V_{IL}; $\overline{CNTRST}$ = V_{IH}.
58. The “Internal Address” is equal to the “External Address” when $\overline{ADS}$ = $\overline{CNTEN}$ = V_{IL} and $\overline{CNTRST}$ = V_{IH}.

Switching Waveforms *(continued)*

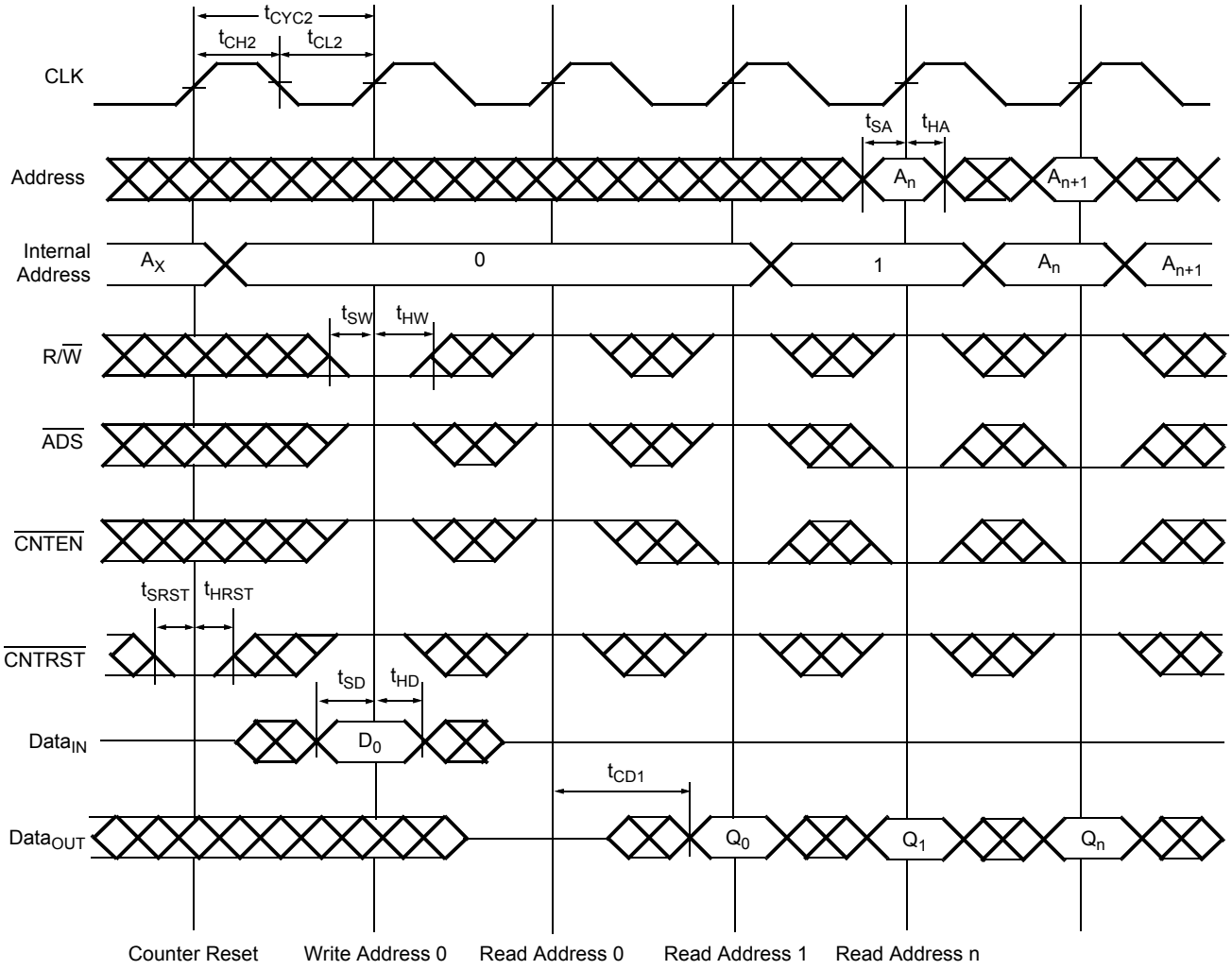
Figure 19. Counter Reset (Pipelined Outputs) [59, 60, 61, 62, 63]



Notes
59. Test conditions used are Load 2.
60. Output state (HIGH, LOW, or High-Impedance) is determined by the previous cycle control signals.
61. $\overline{CE}$ = $\overline{B0}$ = $\overline{B1}$ = $\overline{B2}$ = $\overline{B3}$ = V_{IL}.
62. No dead cycle exists during counter reset. A READ or WRITE cycle may be coincidental with the counter reset.
63. Output state (HIGH, LOW, or High-Impedance) is determined by the previous cycle control signals. Ideally, $DATA_{OUT}$ should be in the High-Impedance state during a valid WRITE cycle.

Switching Waveforms *(continued)*

Figure 20. Counter Reset (Flow-Through Outputs) [64, 65, 66, 67, 68]



Notes

64. Output state (HIGH, LOW, or High-Impedance) is determined by the previous cycle control signals.
65. During "No Operation," data in memory at the selected address may be corrupted and should be rewritten to ensure data integrity.
66. $\overline{CE}$ = $\overline{B0}$ = $\overline{B1}$ = $\overline{B2}$ = $\overline{B3}$ = V_{IL}.
67. No dead cycle exists during counter reset. A READ or WRITE cycle may be coincidental with the counter reset.
68. Output state (HIGH, LOW, or High-Impedance) is determined by the previous cycle control signals. Ideally, $DATA_{OUT}$ should be in the High-Impedance state during a valid WRITE cycle.

Switching Waveforms *(continued)*

Figure 21. Pipelined Read of State of Address Counter [69, 70, 71]

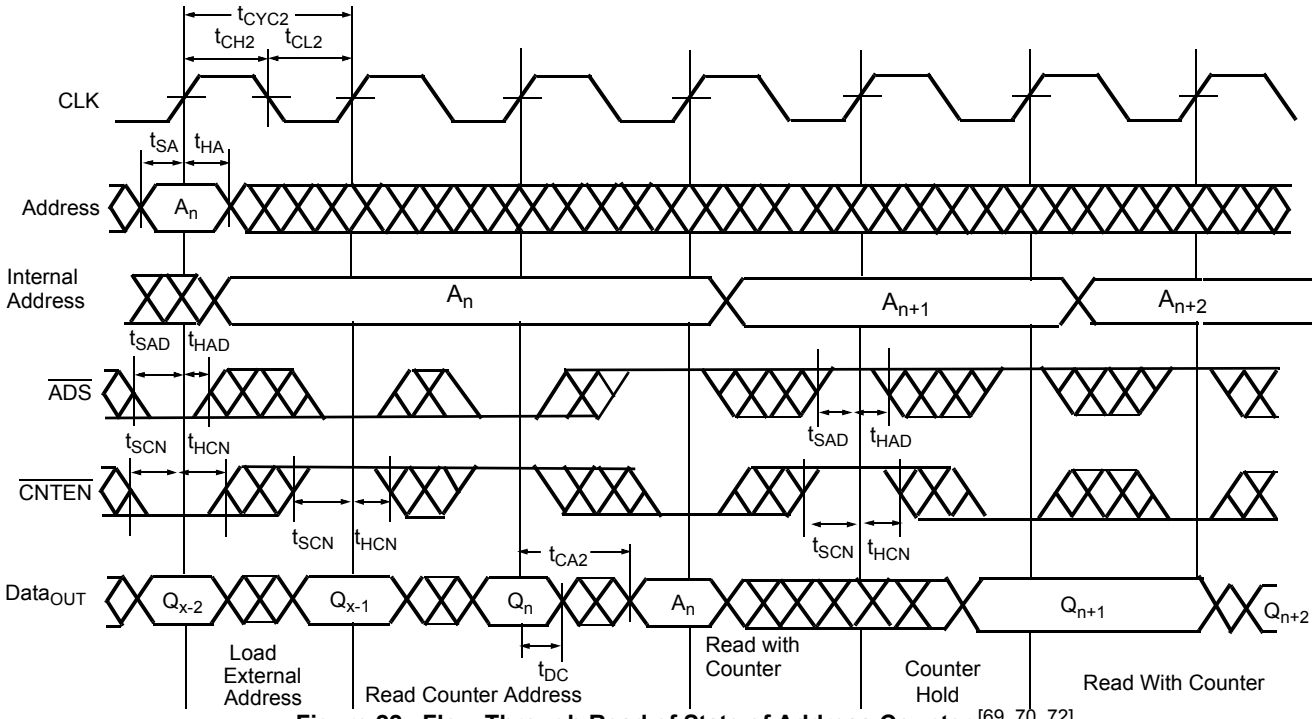
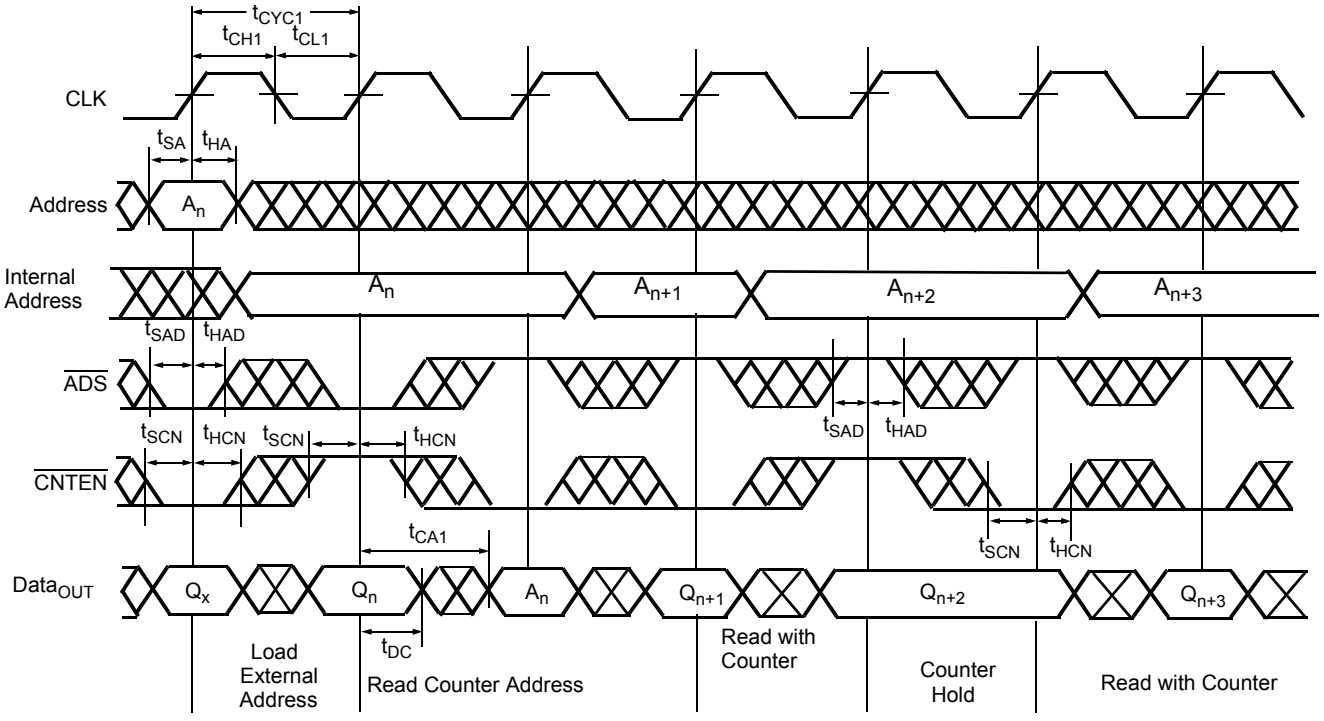


Figure 22. Flow-Through Read of State of Address Counter [69, 70, 72]



Notes
69. $\overline{CE}$ = $\overline{OE}$ = V_{IL}; R/$\overline{W}$ = $\overline{CNTRST}$ = V_{IH}.
70. When reading $ADDRESS_{OUT}$ in x 9 Bus Match mode, readout of A_N is extended by 1 cycle.
71. For Pipelined address counter read, signals from address counter operation table from must be valid for 2 consecutive cycles for x 36 and x 18 mode and for 3 consecutive cycles for x 9 mode.
72. For flow-through address counter read, signals from address counter operation table must be valid for consecutive cycles for x 36.

Read/Write and Enable Operation

The Read/Write and Enable Operation is described as follows. [73, 74, 75]

Inputs				Outputs	Operation
$\overline{OE}$	CLK	$\overline{CE}$	R/$\overline{W}$	I/O_0–I/O_{35}	
X	↑	H	X	High Z	Deselected [76]
X	↑	L	L	D_{IN}	Write
L	↑	L	H	D_{OUT}	Read[76]
H	X	L	X	High Z	Outputs disabled

Address Counter Control Operation

The Address Counter Control Operation is described as follows. [73, 77]

Address	Previous Address	CLK	$\overline{OE}$	R/$\overline{W}$	$\overline{ADS}$	$\overline{CNTEN}$	$\overline{CNTRST}$	Mode	Operation
X	X	↑	X	X	X	X	L	Reset	Counter reset
A_n	X	↑	X	X	L	L	H	Load	Address load into counter
A_n	A_n	↑	L	H	L	H	H	Hold + Read	External address blocked – counter address readout
X	A_n	↑	X	X	H	H	H	Hold	External address blocked – counter disabled
X	A_n	↑	X	X	H	L	H	Increment	Counter increment

Notes
73. "X" = "Don't Care," "H" = V_{IH}, "L" = V_{IL}.
74. $\overline{ADS}$, CNTEN, $\overline{CNTRST}$ = "Don't Care."
75. $\overline{OE}$ is an asynchronous input signal.
76. When $\overline{CE}$ changes state In the pipelined mode, deselection and read happen in the following clock cycle.
77. Counter operation is independent of $\overline{CE}$.

Right Port Configuration

The Right Port Configuration is described as follows. [78, 79]

BM	SIZE	Configuration	I/O Pins used
0	0	× 36	$I/O_{0R–35R}$
1	0	× 18	$I/O_{0R–17R}$
1	1	× 9	$I/O_{0R–8R}$

Right Port Operation

The Right Port Operation is described as follows. [80]

Configuration	BE	Data on 1st Cycle	Data on 2nd Cycle	Data on 3rd Cycle	Data on 4th Cycle
× 18	0	$Q_{0R–17R}$	$Q_{18R–35R}$	–	–
× 18	1	$Q_{18R–35R}$	$Q_{0R–17R}$	–	–
× 9	0	$Q_{0R–8R}$	$Q_{9R–17R}$	$Q_{18R–26R}$	$Q_{27R–35R}$
× 9	1	$Q_{27R–35R}$	$Q_{18R–26R}$	$Q_{9R–17R}$	$Q_{0R–8R}$

Readout of Internal Address Counter

The Readout of Internal Address Counter is described as follows. [81]

Configuration	Address on 1st Cycle	I/O Pins used on 1st Cycle	Address on 2nd Cycle	I/O Pins used on 2nd Cycle
Left Port × 36	$A_{0L–14L}$	$I/O_{3L–17L}$	–	–
Right Port × 36	$A_{0R–14R}$	$I/O_{3R–17R}$	–	–
Right Port × 18	WA, $A_{0R–14R}$	$I/O_{2R–17R}$	–	–
Right Port × 9	$A_{6R–14R}$	$I/O_{0R–8R}$	BA, WA, $A_{0R–5R}$	$I/O_{1R–8R}$

Left Port Operation

The Left Port Operation is described as follows.

Control Pin	Effect
$\overline{B0}$	$I/O_{0–8}$ Byte Control
$\overline{B1}$	$I/O_{9–17}$ Byte Control
$\overline{B2}$	$I/O_{18–26}$ Byte Control
$\overline{B3}$	$I/O_{27–35}$ Byte Control

Notes
78. BM, SIZE, and BE must be reconfigured 1 cycle before operation is guaranteed. BM, SIZE, and BE should remain static for any particular port configuration.
79. In x36 mode, BE input is a “Don’t Care.”
80. DQ represents data output of the chip.
81. x18 and x9 configuration apply to right port only.