



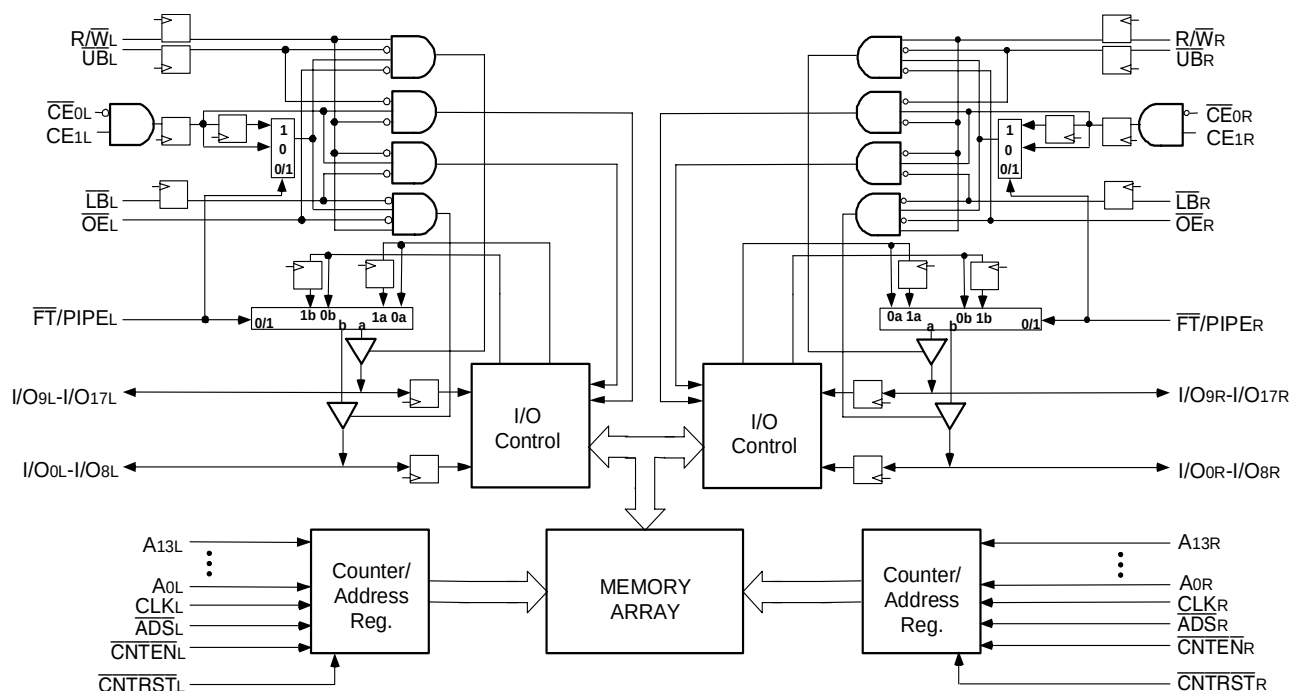
HIGH-SPEED 3.3V 16K x 18 SYNCHRONOUS PIPELINED DUAL-PORT STATIC RAM

IDT70V9369L

Features:

- ♦ True Dual-Ported memory cells which allow simultaneous access of the same memory location
- ♦ High-speed clock to data access
 - Commercial: 6/7.5/9/12ns (max.)
 - Industrial: 7.5ns (max.)
- ♦ Low-power operation
 - IDT70V9369L
 - Active: 500mW (typ.)
 - Standby: 1.5mW (typ.)
- ♦ Flow-Through or Pipelined output mode on either port via the $\overline{\text{FT}}/\text{PIPE}$ pins
- ♦ Counter enable and reset features
- ♦ Dual chip enables allow for depth expansion without additional logic
- ♦ Full synchronous operation on both ports
 - 4ns setup to clock and 0ns hold on all control, data, and address inputs
 - Data input, address, and control registers
 - Fast 6.5ns clock to data out in the Pipelined output mode
 - Self-timed write allows fast cycle time
 - 12ns cycle time, 83MHz operation in Pipelined output mode
- ♦ Separate upper-byte and lower-byte controls for multiplexed bus and bus matching compatibility
- ♦ LVTTTL-compatible, single 3.3V ($\pm 0.3\text{V}$) power supply
- ♦ Industrial temperature range (-40°C to $+85^{\circ}\text{C}$) is available for selected speeds
- ♦ Available in a 100-pin Thin Quad Flatpack (TQFP)

Functional Block Diagram



5648 drw 01

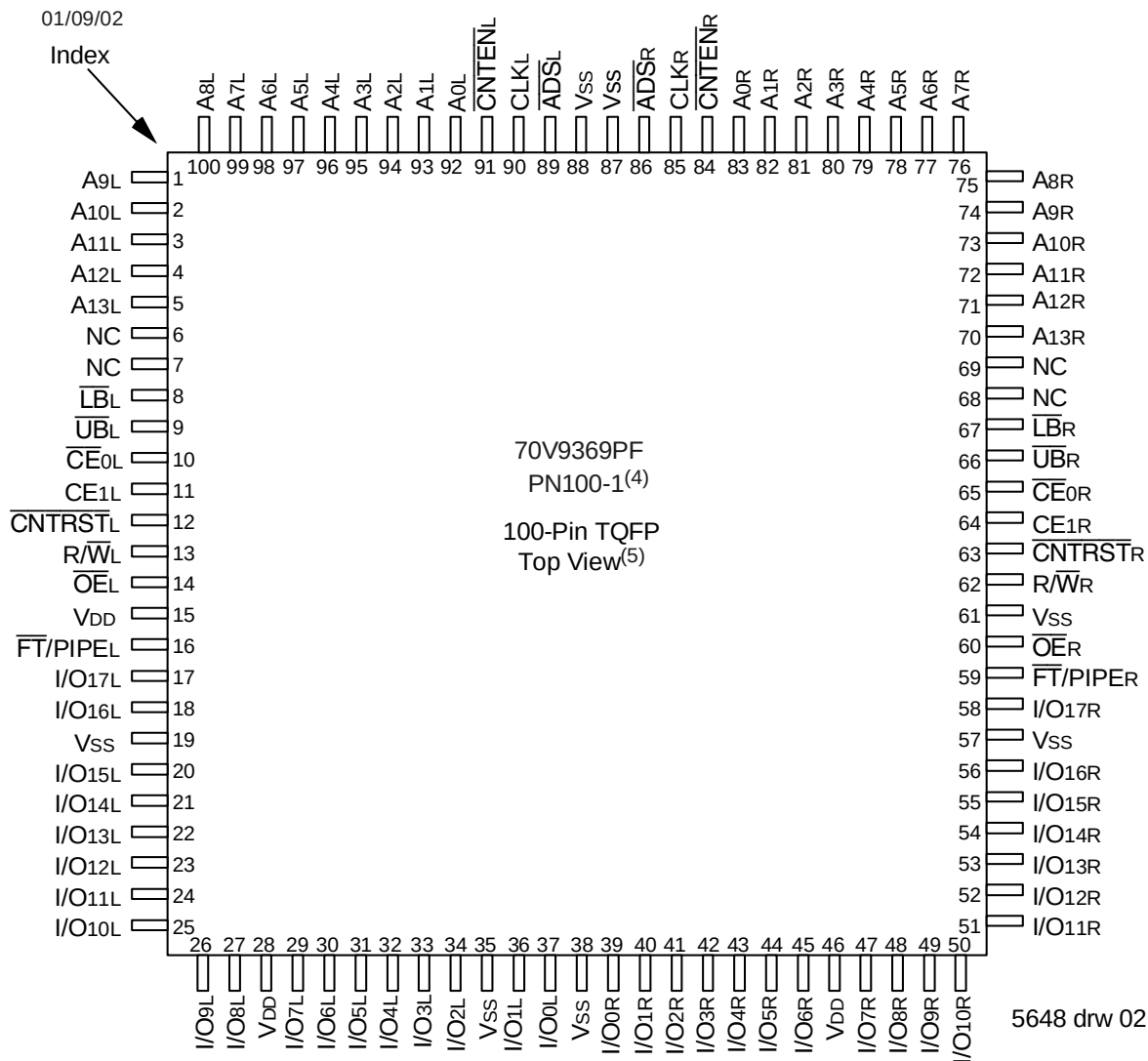
OCTOBER 2008

Description:

The IDT70V9369 is a high-speed 16K x 18 bit synchronous Dual-Port RAM. The memory array utilizes Dual-Port memory cells to allow simultaneous access of any address from both ports. Registers on control, data, and address inputs provide minimal setup and hold times. The timing latitude provided by this approach allows systems to be designed with very short cycle times.

With an input data register, the IDT70V9369 has been optimized for applications having unidirectional or bidirectional data flow in bursts. An automatic power down feature, controlled by $\overline{CE_0}$ and CE_1 , permits the on-chip circuitry of each port to enter a very low standby power mode. Fabricated using IDT's CMOS high-performance technology, these devices typically operate on only 500mW of power.

Pin Configuration^(1,2,3)



NOTES:

1. All V_{DD} pins must be connected to power supply.
2. All V_{SS} pins must be connected to ground.
3. Package body is approximately 14mm x 14mm x 1.4mm.
4. This package code is used to reference the package diagram.
5. This text does not indicate orientation of the actual part-marking.

Pin Names

Left Port	Right Port	Names
$\overline{CE}_{0L}$, CE_{1L}	$\overline{CE}_{0R}$, CE_{1R}	Chip Enables ⁽²⁾
$R/\overline{WL}$	$R/\overline{WR}$	Read/Write Enable
$\overline{OE}_L$	$\overline{OE}_R$	Output Enable
A0L - A13L	A0R - A13R	Address
I/O0L - I/O17L	I/O0R - I/O17R	Data Input/Output
CLKL	CLKR	Clock
$\overline{UB}_L$	$\overline{UB}_R$	Upper Byte Select ⁽¹⁾
$\overline{LB}_L$	$\overline{LB}_R$	Lower Byte Select ⁽¹⁾
$\overline{ADS}_L$	$\overline{ADS}_R$	Address Strobe Enable
$\overline{CNTEN}_L$	$\overline{CNTEN}_R$	Counter Enable
$\overline{CNTRST}_L$	$\overline{CNTRST}_R$	Counter Reset
$\overline{FT}/PIPEL$	$\overline{FT}/PIPER$	Flow-Through / Pipeline
VDD		Power (3.3V)
VSS		Ground (0V)

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NOTES:

- $\overline{LB}$ and $\overline{UB}$ are single buffered regardless of state of $\overline{FT}/PIPE$.
- $\overline{CE}_0$ and CE_1 are single buffered when $\overline{FT}/PIPE = V_{IL}$,
 $\overline{CE}_0$ and CE_1 are double buffered when $\overline{FT}/PIPE = V_{IH}$, i.e., the signals take two cycles to deselect.

Truth Table I—Read/Write and Enable Control^(1,2,3)

$\overline{OE}$	CLK	$\overline{CE}_0$	CE_1	$\overline{UB}$	$\overline{LB}$	$R/\overline{W}$	Upper Byte I/O ₉₋₁₇ ⁽⁴⁾	Lower Byte I/O ₀₋₈ ⁽⁵⁾	MODE
X	↑	H	X	X	X	X	High-Z	High-Z	Deselected—Power Down
X	↑	X	L	X	X	X	High-Z	High-Z	Deselected—Power Down
X	↑	L	H	H	H	X	High-Z	High-Z	Both Bytes Deselected
X	↑	L	H	L	H	L	DATA _{IN}	High-Z	Write to Upper Byte Only
X	↑	L	H	H	L	L	High-Z	DATA _{IN}	Write to Lower Byte Only
X	↑	L	H	L	L	L	DATA _{IN}	DATA _{IN}	Write to Both Bytes
L	↑	L	H	L	H	H	DATA _{OUT}	High-Z	Read Upper Byte Only
L	↑	L	H	H	L	H	High-Z	DATA _{OUT}	Read Lower Byte Only
L	↑	L	H	L	L	H	DATA _{OUT}	DATA _{OUT}	Read Both Bytes
H	X	L	H	L	L	X	High-Z	High-Z	Outputs Disabled

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NOTES:

- "H" = V_{IH} , "L" = V_{IL} , "X" = Don't Care.
- $\overline{ADS}$, $\overline{CNTEN}$, $\overline{CNTRST}$ = X.
- $\overline{OE}$ is an asynchronous input signal.

Truth Table II—Address Counter Control^(1,2,6)

Address	Previous Internal Address	Internal Address Used	CLK ⁽⁶⁾	$\overline{ADS}$	$\overline{CNTEN}$	$\overline{CNTRST}$	I/O ⁽³⁾	MODE
An	X	An	↑	L ⁽⁴⁾	X	H	D _{IO} (n)	External Address Used
X	An	An + 1	↑	H	L ⁽⁵⁾	H	D _{IO} (n+1)	Counter Enabled—Internal Address generation
X	An + 1	An + 1	↑	H	H	H	D _{IO} (n+1)	External Address Blocked—Counter disabled (An + 1 reused)
X	X	A0	↑	X	X	L ⁽⁴⁾	D _{IO} (0)	Counter Reset to Address 0

NOTES:

- "H" = V_{IH}, "L" = V_{IL}, "X" = Don't Care.
- $\overline{CE0}$, $\overline{LB}$, $\overline{UB}$, and $\overline{OE}$ = V_{IL}; CE₁ and $\overline{R/W}$ = V_{IH}.
- Outputs configured in Flow-Through Output mode; if outputs are in Pipelined mode the data out will be delayed by one cycle.
- $\overline{ADS}$ and $\overline{CNTRST}$ are independent of all other signals including $\overline{CE0}$, CE₁, $\overline{UB}$ and $\overline{LB}$.
- The address counter advances if $\overline{CNTEN}$ = V_{IL} on the rising edge of CLK, regardless of all other signals including $\overline{CE0}$, CE₁, $\overline{UB}$ and $\overline{LB}$.
- While an external address is being loaded ($\overline{ADS}$ = V_{IL}), $\overline{R/W}$ = V_{IH} is recommended to ensure data is not written arbitrarily.

5648 tbl 03

Recommended Operating Temperature and Supply Voltage⁽¹⁾

Grade	Ambient Temperature ⁽¹⁾	GND	V _{DD}
Commercial	0°C to +70°C	0V	3.3V ± 0.3V
Industrial	-40°C to +85°C	0V	3.3V ± 0.3V

5648 tbl 04

NOTES:

- This is the parameter T_A. This is the "instant on" case temperature.

Recommended DC Operating Conditions

Symbol	Parameter	Min.	Typ.	Max.	Unit
V _{DD}	Supply Voltage	3.0	3.3	3.6	V
V _{SS}	Ground	0	0	0	V
V _{IH}	Input High Voltage	2.0V	—	V _{DD} +0.3V ⁽²⁾	V
V _{IL}	Input Low Voltage	-0.3 ⁽¹⁾	—	0.8	V

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NOTES:

- V_{IL} ≥ -1.5V for pulse width less than 10 ns.
- V_{TERM} must not exceed V_{DD} +0.3V.

Absolute Maximum Ratings⁽¹⁾

Symbol	Rating	Commercial & Industrial	Unit
V _{TERM} ⁽²⁾	Terminal Voltage with Respect to GND	-0.5 to +4.6	V
T _{BIAS} ⁽³⁾	Temperature Under Bias	-55 to +125	°C
T _{STG}	Storage Temperature	-65 to +150	°C
T _{JN}	Junction Temperature	+150	°C
I _{OUT}	DC Output Current	50	mA

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NOTES:

- Stresses greater than those listed under ABSOLUTE MAXIMUM RATINGS may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect reliability.
- V_{TERM} must not exceed V_{DD} +0.3V.
- Ambient Temperature Under DC Bias. No AC Conditions. Chip deselect.

Capacitance⁽¹⁾(T_A = +25°C, f = 1.0MHz)

Symbol	Parameter	Conditions	Max.	Unit
C _{IN}	Input Capacitance	V _{IN} = 0V	9	pF
C _{OUT} ⁽²⁾	Output Capacitance	V _{OUT} = 0V	10	pF

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NOTES:

- These parameters are determined by device characterization, but are not production tested.
- C_{OUT} also references C_{I/O}.

DC Electrical Characteristics Over the Operating Temperature and Supply Voltage Range ($V_{DD} = 3.3V \pm 0.3V$)

Symbol	Parameter	Test Conditions	70V9369L		Unit
			Min.	Max.	
$ I_{IL} $	Input Leakage Current ⁽¹⁾	$V_{DD} = 3.6V$, $V_{IN} = 0V$ to V_{DD}	—	5	μA
$ I_{LO} $	Output Leakage Current	$\overline{CE}_O = V_{IH}$ or $CE_1 = V_{IL}$, $V_{OUT} = 0V$ to V_{DD}	—	5	μA
V_{OL}	Output Low Voltage	$I_{OL} = +4mA$	—	0.4	V
V_{OH}	Output High Voltage	$I_{OH} = -4mA$	2.4	—	V

NOTE:

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1. At $V_{DD} \leq 2.0V$ input leakages are undefined.

DC Electrical Characteristics Over the Operating Temperature Supply Voltage Range⁽³⁾ ($V_{DD} = 3.3V \pm 0.3V$)

Symbol	Parameter	Test Condition	Version	70V9369L6 Com'l Only		70V9369L7 Com'l & Ind		70V9369L9 Com'l Only		70V9369L12 Com'l Only		Unit	
				Typ. ⁽⁴⁾	Max.	Typ. ⁽⁴⁾	Max.	Typ. ⁽⁴⁾	Max.	Typ. ⁽⁴⁾	Max.		
I _{DD}	Dynamic Operating Current (Both Ports Active)	$\overline{CE}_L$ and $\overline{CE}_R = V_{IL}$, Outputs Disabled, $f = f_{MAX}^{(1)}$	COM'L	L	220	350	200	290	180	225	150	205	mA
			IND	L	—	—	200	335	—	—	—	—	
ISB1	Standby Current (Both Ports - TTL Level Inputs)	$\overline{CE}_L = \overline{CE}_R = V_{IH}$ $f = f_{MAX}^{(1)}$	COM'L	L	70	130	65	100	50	65	40	50	mA
			IND	L	—	—	65	115	—	—	—	—	
ISB2	Standby Current (One Port - TTL Level Inputs)	$\overline{CE}^*A^* = V_{IL}$ and $\overline{CE}^*B^* = V_{IH}^{(5)}$ Active Port Outputs Disabled, $f = f_{MAX}^{(1)}$	COM'L	L	150	250	140	210	110	150	100	140	mA
			IND	L	—	—	140	240	—	—	—	—	
ISB3	Full Standby Current (Both Ports - CMOS Level Inputs)	Both Ports $\overline{CE}_L$ and $\overline{CE}_R \geq V_{DD} - 0.2V$, $V_{IN} \geq V_{DD} - 0.2V$ or $V_{IN} \leq 0.2V$, $f = 0^{(2)}$	COM'L	L	0.4	5	0.4	5	0.4	5	0.4	5	mA
			IND	L	—	—	0.4	15	—	—	—	—	
ISB4	Full Standby Current (One Port - CMOS Level Inputs)	$\overline{CE}^*A^* \leq 0.2V$ and $\overline{CE}^*B^* \geq V_{DD} - 0.2V^{(5)}$ $V_{IN} \geq V_{DD} - 0.2V$ or $V_{IN} \leq 0.2V$, Active Port, Outputs Disabled, $f = f_{MAX}^{(1)}$	COM'L	L	140	240	130	200	100	140	90	130	mA
			IND	L	—	—	130	230	—	—	—	—	

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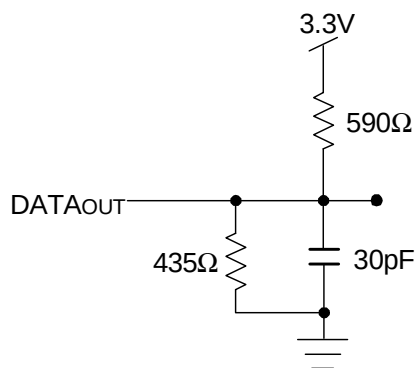
NOTES:

- At $f = f_{MAX}$, address and control lines (except Output Enable) are cycling at the maximum frequency clock cycle of $1/t_{cvc}$, using "AC TEST CONDITIONS" at input levels of GND to 3V.
- $f = 0$ means no address, clock, or control lines change. Applies only to input at CMOS level standby.
- Port "A" may be either left or right port. Port "B" is the opposite from port "A".
- $V_{DD} = 3.3V$, $T_A = 25^\circ C$ for Typ, and are not production tested. $I_{DD} dc(f=0) = 90mA$ (Typ).
- $\overline{CE}_X = V_{IL}$ means $\overline{CE}_{0X} = V_{IL}$ and $CE_{1X} = V_{IH}$
 $\overline{CE}_X = V_{IH}$ means $\overline{CE}_{0X} = V_{IH}$ or $CE_{1X} = V_{IL}$
 $\overline{CE}_X \leq 0.2V$ means $\overline{CE}_{0X} \leq 0.2V$ and $CE_{1X} \geq V_{DD} - 0.2V$
 $\overline{CE}_X \geq V_{DD} - 0.2V$ means $\overline{CE}_{0X} \geq V_{DD} - 0.2V$ or $CE_{1X} \leq 0.2V$
 "X" represents "L" for left port or "R" for right port.

AC Test Conditions

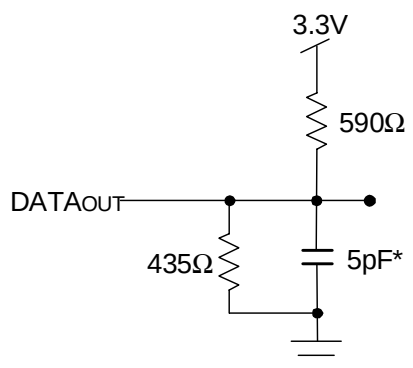
Input Pulse Levels	GND to 3.0V
Input Rise/Fall Times	3ns Max.
Input Timing Reference Levels	1.5V
Output Reference Levels	1.5V
Output Load	Figures 1, 2, and 3

5648 tbl 10



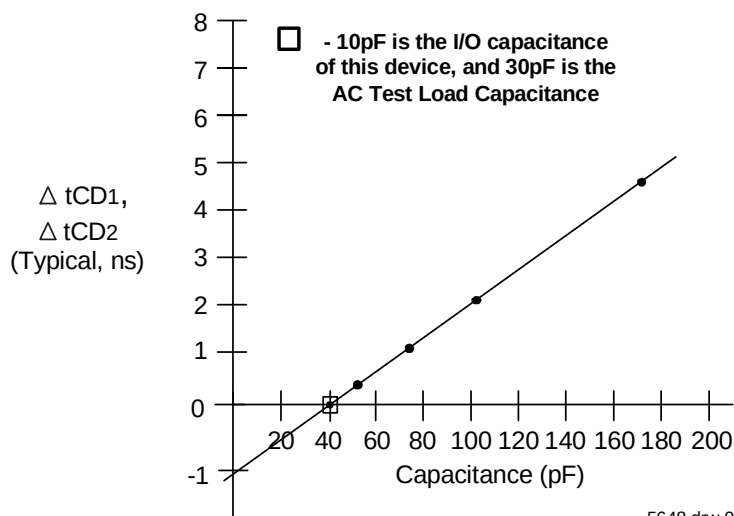
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Figure 1. AC Output Test load.



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Figure 2. Output Test Load
(For tCKLZ, tCKHZ, tOLZ, and tOHZ).
*Including scope and jig.



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Figure 3. Typical Output Derating (Lumped Capacitive Load).

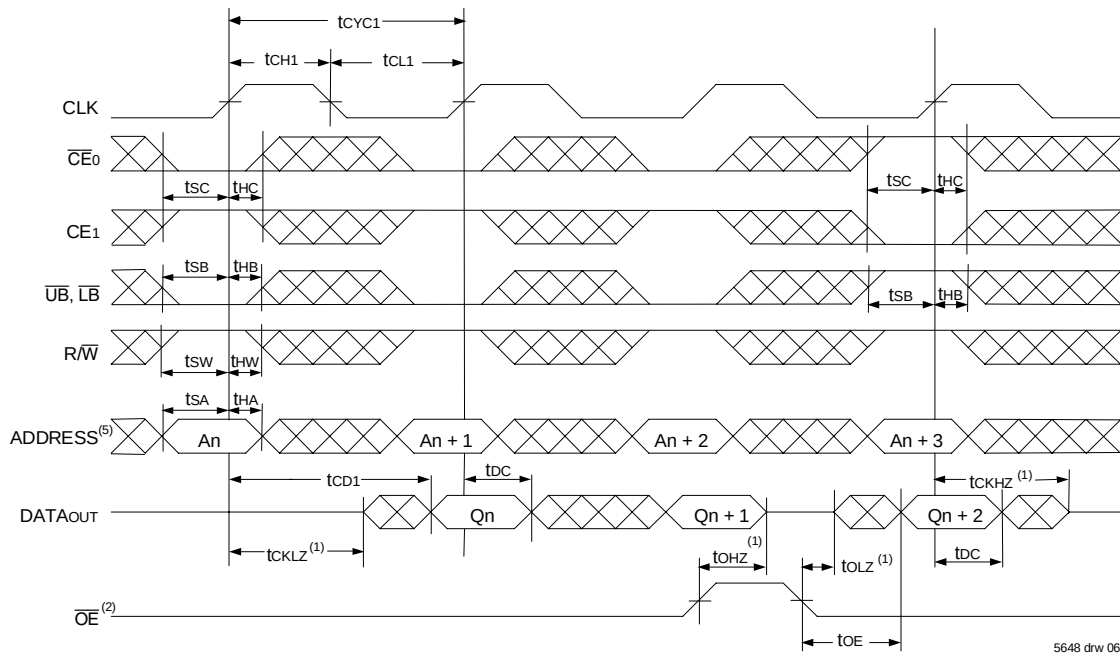
AC Electrical Characteristics Over the Operating Temperature Range (Read and Write Cycle Timing)⁽³⁾ ($V_{DD} = 3.3V \pm 0.3V$, $T_A = 0^\circ C$ to $+70^\circ C$)

Symbol	Parameter	70V9369L6 Com'l Only		70V9369L7 Com'l Only & Ind		70V9369L9 Com'l Only		70V9369L12 Com'l Only		Unit
		Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	
tcyc1	Clock Cycle Time (Flow-Through) ⁽²⁾	19	—	22	—	25	—	30	—	ns
tcyc2	Clock Cycle Time (Pipelined) ⁽²⁾	10	—	12	—	15	—	20	—	ns
tch1	Clock High Time (Flow-Through) ⁽²⁾	6.5	—	7.5	—	12	—	12	—	ns
tcl1	Clock Low Time (Flow-Through) ⁽²⁾	6.5	—	7.5	—	12	—	12	—	ns
tch2	Clock High Time (Pipelined) ⁽²⁾	4	—	5	—	6	—	8	—	ns
tcl2	Clock Low Time (Pipelined) ⁽²⁾	4	—	5	—	6	—	8	—	ns
tr	Clock Rise Time	—	3	—	3	—	3	—	3	ns
tf	Clock Fall Time	—	3	—	3	—	3	—	3	ns
tsa	Address Setup Time	3.5	—	4	—	4	—	4	—	ns
tba	Address Hold Time	0	—	0	—	1	—	1	—	ns
tsc	Chip Enable Setup Time	3.5	—	4	—	4	—	4	—	ns
tbc	Chip Enable Hold Time	0	—	0	—	1	—	1	—	ns
tsw	R/W Setup Time	3.5	—	4	—	4	—	4	—	ns
tww	R/W Hold Time	0	—	0	—	1	—	1	—	ns
tsd	Input Data Setup Time	3.5	—	4	—	4	—	4	—	ns
tdd	Input Data Hold Time	0	—	0	—	1	—	1	—	ns
tsad	$\overline{ADS}$ Setup Time	3.5	—	4	—	4	—	4	—	ns
tbad	$\overline{ADS}$ Hold Time	0	—	0	—	1	—	1	—	ns
tsCN	$\overline{CNTEN}$ Setup Time	3.5	—	4	—	4	—	4	—	ns
tbcN	$\overline{CNTEN}$ Hold Time	0	—	0	—	1	—	1	—	ns
tsRST	$\overline{CNRST}$ Setup Time	3.5	—	4	—	4	—	4	—	ns
tbrst	$\overline{CNRST}$ Hold Time	0	—	0	—	1	—	1	—	ns
toE	Output Enable to Data Valid	—	6.5	—	7.5	—	9	—	12	ns
toLZ	Output Enable to Output Low-Z ⁽¹⁾	2	—	2	—	2	—	2	—	ns
toHZ	Output Enable to Output High-Z ⁽¹⁾	1	7	1	7	1	7	1	7	ns
tcd1	Clock to Data Valid (Flow-Through) ⁽²⁾	—	15	—	18	—	20	—	25	ns
tcd2	Clock to Data Valid (Pipelined) ⁽²⁾	—	6.5	—	7.5	—	9	—	12	ns
tdc	Data Output Hold After Clock High	2	—	2	—	2	—	2	—	ns
tckHZ	Clock High to Output High-Z ⁽¹⁾	2	9	2	9	2	9	2	9	ns
tckLZ	Clock High to Output Low-Z ⁽¹⁾	2	—	2	—	2	—	2	—	ns
Port-to-Port Delay										
tcWDD	Write Port Clock High to Read Data Delay	—	24	—	28	—	35	—	40	ns
tccs	Clock-to-Clock Setup Time	—	9	—	10	—	15	—	15	ns

NOTES:

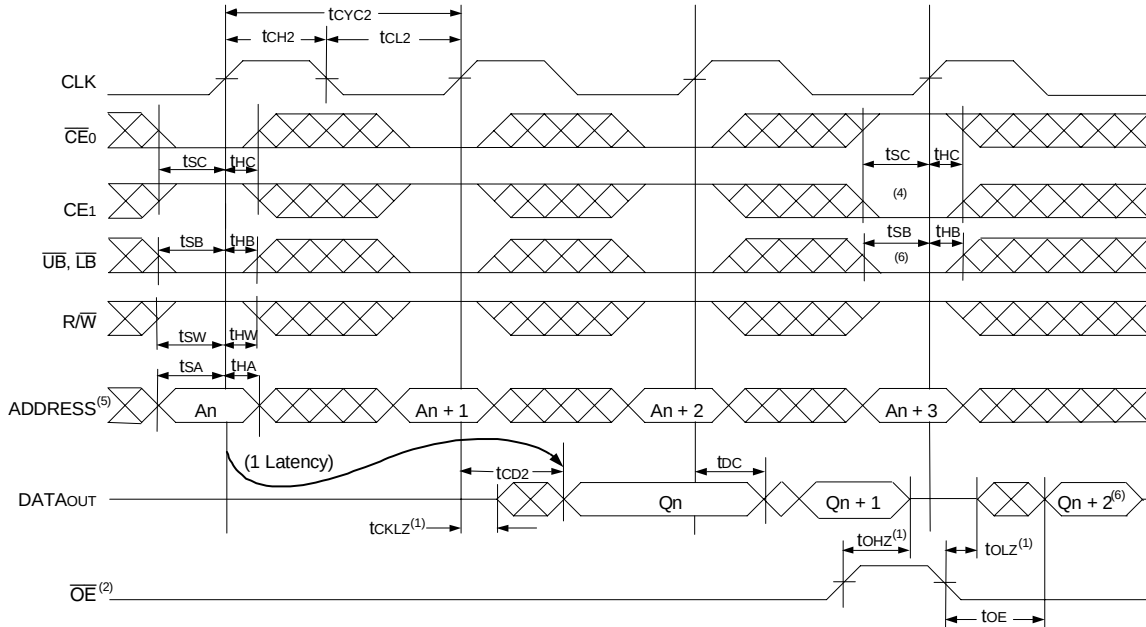
1. Transition is measured 0mV from Low or High-impedance voltage with the Output Test Load (Figure 2). This parameter is guaranteed by device characterization, but is not production tested.
2. The Pipelined output parameters (tcyc2, tcd2) apply to either or both the Left and Right ports when $\overline{FT}/PIPE = V_{IH}$. Flow-through parameters (tcyc1, tcd1) apply when $\overline{FT}/PIPE = V_{IL}$ for that port.
3. All input signals are synchronous with respect to the clock except for the asynchronous Output Enable ($\overline{OE}$), $\overline{FT}/PIPE_R$, and $\overline{FT}/PIPE_L$.

Timing Waveform of Read Cycle for Flow-Through Output

 $(\overline{\text{FT}}/\text{PIPE} "X" = V_{IL})^{(3,7)}$ 

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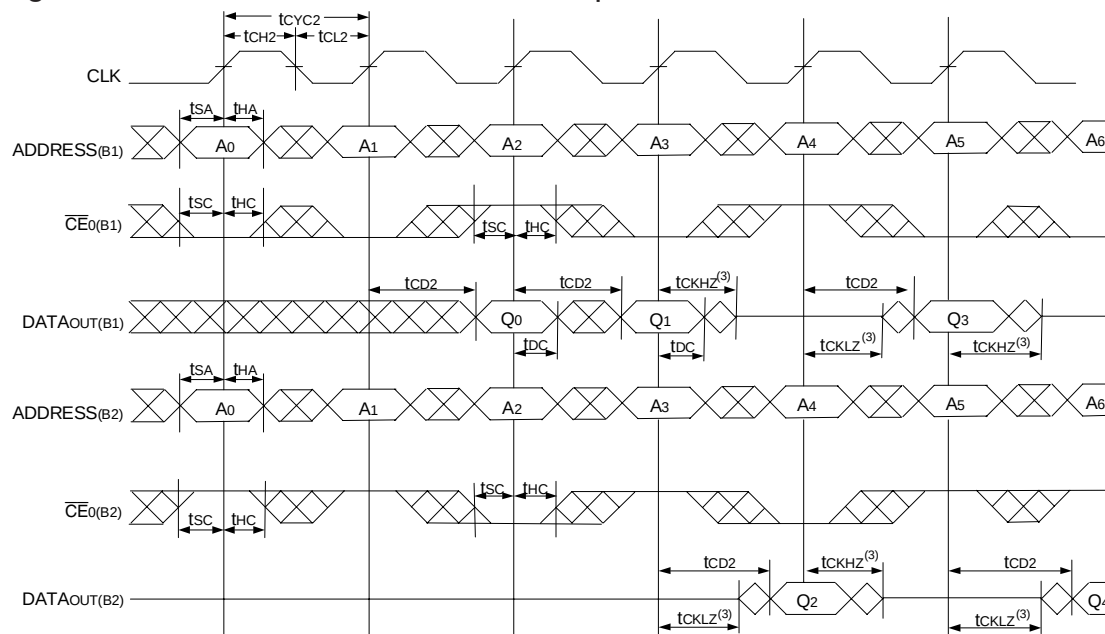
Timing Waveform of Read Cycle for Pipelined Operation

 $(\overline{\text{FT}}/\text{PIPE} "X" = V_{IH})^{(3,7)}$ 

5648 drw 07

NOTES:

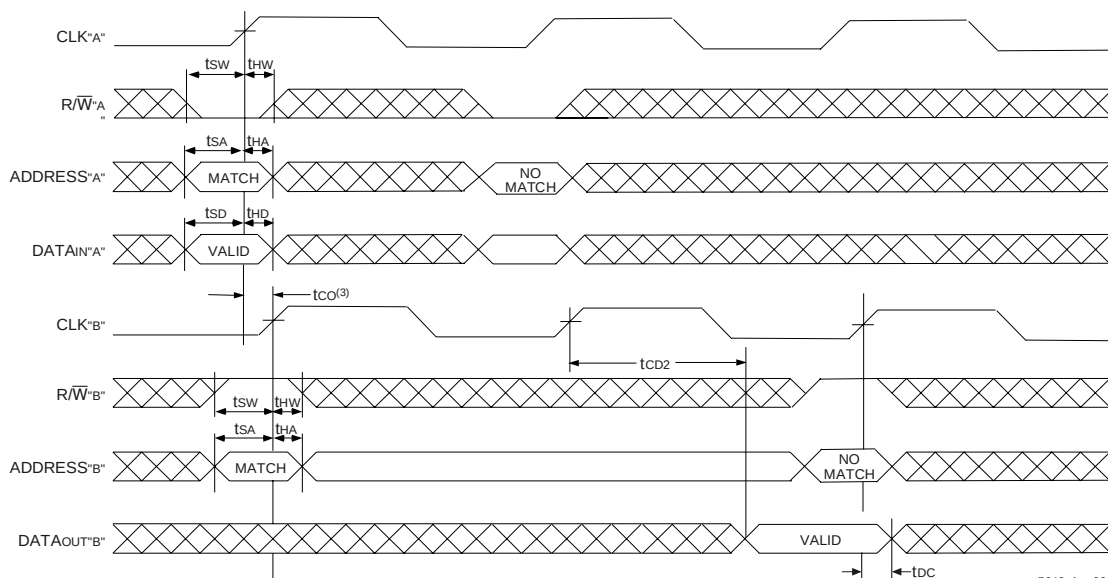
1. Transition is measured 0mV from Low or High-impedance voltage with the Output Test Load (Figure 2).
2. $\overline{\text{OE}}$ is asynchronously controlled; all other inputs are synchronous to the rising clock edge.
3. $\overline{\text{ADS}} = V_{IL}$, $\overline{\text{CNTEN}}$ and $\overline{\text{CNTRST}} = V_{IH}$.
4. The output is disabled (High-Impedance state) by $\overline{\text{CE}}_0 = V_{IH}$, $\text{CE}_1 = V_{IL}$, $\overline{\text{UB}} = V_{IH}$, or $\overline{\text{LB}} = V_{IH}$ following the next rising edge of the clock. Refer to Notes under Pin Names Table.
5. Addresses do not have to be accessed sequentially since $\overline{\text{ADS}} = V_{IL}$ constantly loads the address on the rising edge of the CLK; numbers are for reference use only.
6. If $\overline{\text{UB}}$ or $\overline{\text{LB}}$ was HIGH, then the Upper Byte and/or Lower Byte of DATAout for Q_{n+2} would be disabled (High-Impedance state).
7. "X" here denotes Left or Right port. The diagram is with respect to that port.

Timing Waveform of a Bank Select Pipelined Read^(1,2)

NOTES:

1. B1 Represents Bank #1; B2 Represents Bank #2. Each Bank consists of one IDT70V9369 for this waveform, and are setup for depth expansion in this example. ADDRESS(B1) = ADDRESS(B2) in this situation.
2. $\overline{UB}$, $\overline{LB}$, $\overline{OE}$, and $\overline{ADS} = V_{IL}$; $\overline{CE1(B1)}$, $\overline{CE1(B2)}$, $R/\overline{W}$, $\overline{CNTEN}$, and $\overline{CNTNST} = V_{IH}$.
3. Transition is measured 0mV from Low or High-impedance voltage with the Output Test Load (Figure 2).
4. $\overline{CE0}$, $\overline{UB}$, $\overline{LB}$, and $\overline{ADS} = V_{IL}$; $\overline{CE1}$, $\overline{CNTEN}$, and $\overline{CNTNST} = V_{IH}$.
5. $\overline{OE} = V_{IL}$ for the Right Port, which is being read from. $\overline{OE} = V_{IH}$ for the Left Port, which is being written to.
6. If $t_{CCS} \leq$ maximum specified, then data from right port READ is not valid until the maximum specified for t_{CWD} .
If $t_{CCS} >$ maximum specified, then data from right port READ is not valid until $t_{CCS} + t_{CD1}$. t_{CWD} does not apply in this case.
7. All timing is the same for both Left and Right ports. Port "A" may be either Left or Right port. Port "B" is the opposite from Port "A".

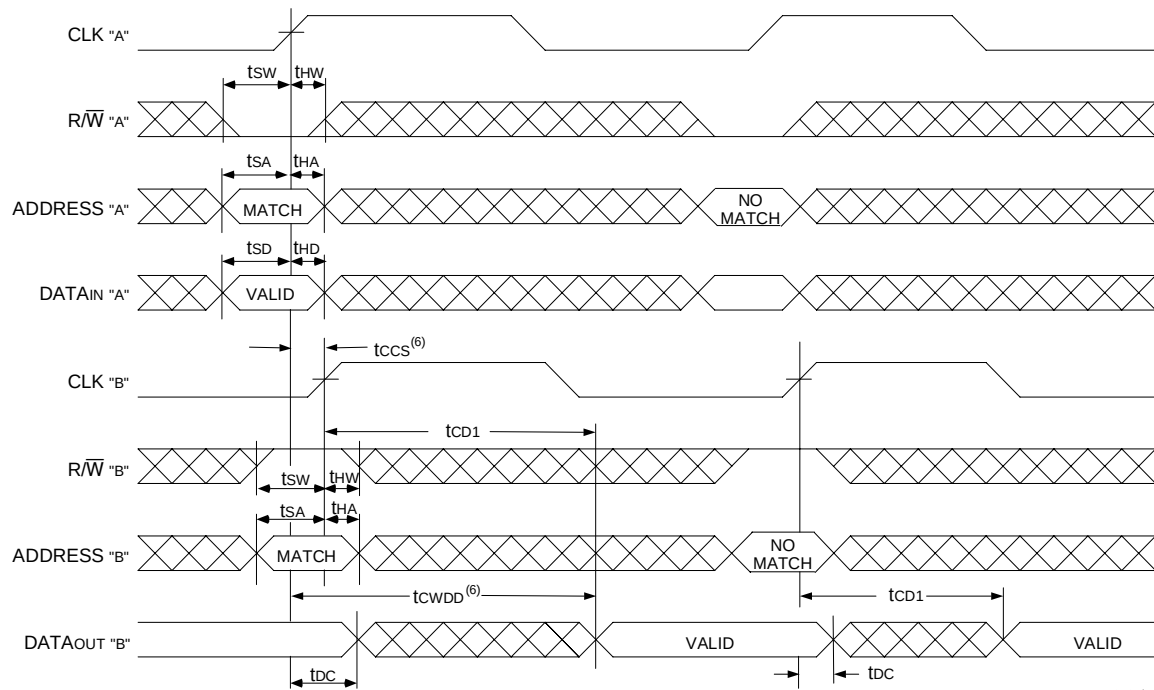
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Timing Waveform of Left Port Write to Pipelined Right Port Read^(1,2,4)

NOTES:

1. $\overline{CE0}$, $\overline{BE_n}$, and $\overline{ADS} = V_{IL}$; $\overline{CE1}$, $\overline{CNTEN}$, and $\overline{REPEAT} = V_{IH}$.
2. $\overline{OE} = V_{IL}$ for Port "B", which is being read from. $\overline{OE} = V_{IH}$ for Port "A", which is being written to.
3. If $t_{CO} \leq$ minimum specified, then data from Port "B" read is not valid until following Port "B" clock cycle (ie, time from write to valid read on opposite port will be $t_{CO} + 2 t_{CYC2} + t_{CD2}$). If $t_{CO} >$ minimum, then data from Port "B" read is available on first Port "B" clock cycle (ie, time from write to valid read on opposite port will be $t_{CO} + t_{CYC2} + t_{CD2}$).
4. All timing is the same for Left and Right ports. Port "A" may be either Left or Right port. Port "B" is the opposite of Port "A".

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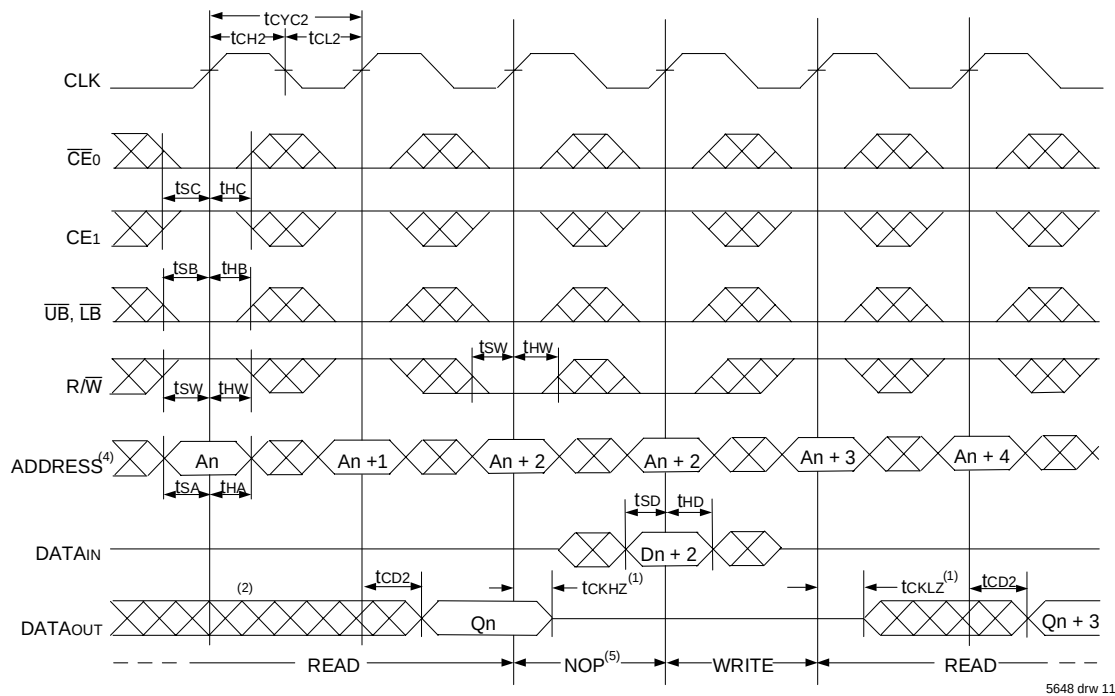
Timing Waveform with Port-to-Port Flow-Through Read^(4,5,7)

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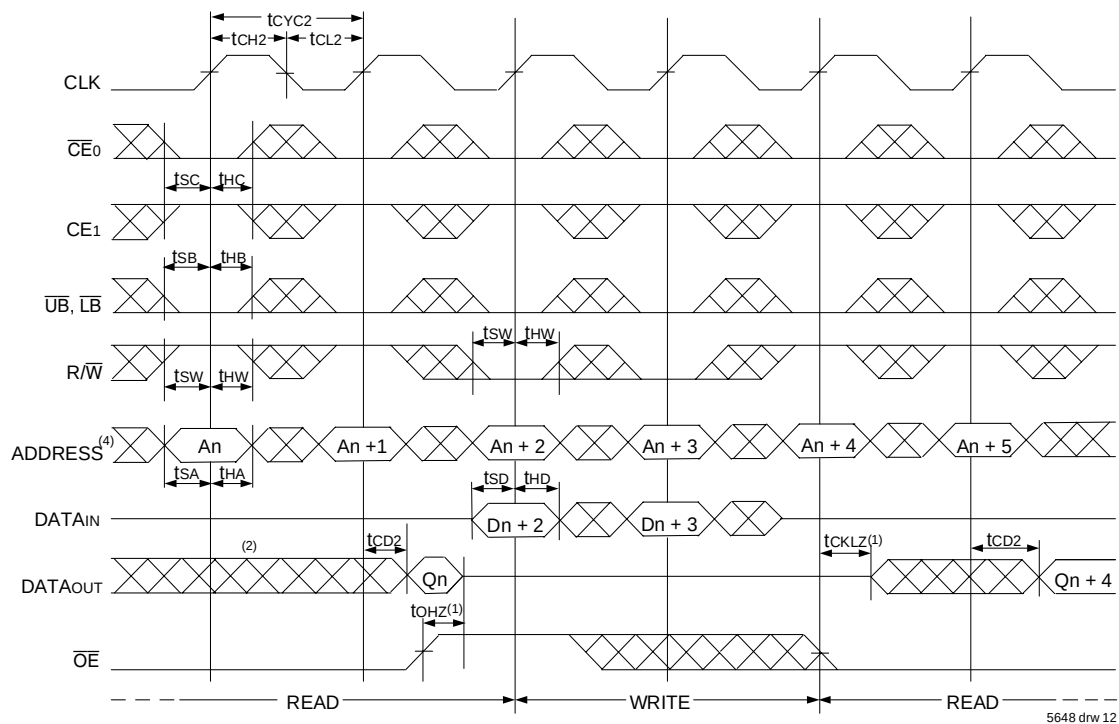
NOTES:

1. B1 Represents Bank #1; B2 Represents Bank #2. Each Bank consists of one IDT70V9369 for this waveform, and are setup for depth expansion in this example. ADDRESS(B1) = ADDRESS(B2) in this situation.
2. $\overline{UB}$, $\overline{LB}$, $\overline{OE}$, and $\overline{ADS} = V_{IL}$; $CE_{1(B1)}$, $CE_{1(B2)}$, R/W , $\overline{CNTEN}$, and $\overline{CNTRST} = V_{IH}$.
3. Transition is measured 0mV from Low or High-impedance voltage with the Output Test Load (Figure 2).
4. $\overline{CE_0}$, $\overline{UB}$, $\overline{LB}$, and $\overline{ADS} = V_{IL}$; CE_1 , $\overline{CNTEN}$, and $\overline{CNTRST} = V_{IH}$.
5. $\overline{OE} = V_{IL}$ for the Right Port, which is being read from. $\overline{OE} = V_{IH}$ for the Left Port, which is being written to.
6. If $t_{CCS} \leq$ maximum specified, then data from right port READ is not valid until the maximum specified for t_{CWD} .
If $t_{CCS} >$ maximum specified, then data from right port READ is not valid until $t_{CCS} + t_{CD1}$. t_{CWD} does not apply in this case.
7. All timing is the same for both Left and Right ports. Port "A" may be either Left or Right port. Port "B" is the opposite from Port "A".

Timing Waveform of Pipelined Read-to-Write-to-Read ($\overline{OE} = V_{IL}$)⁽³⁾

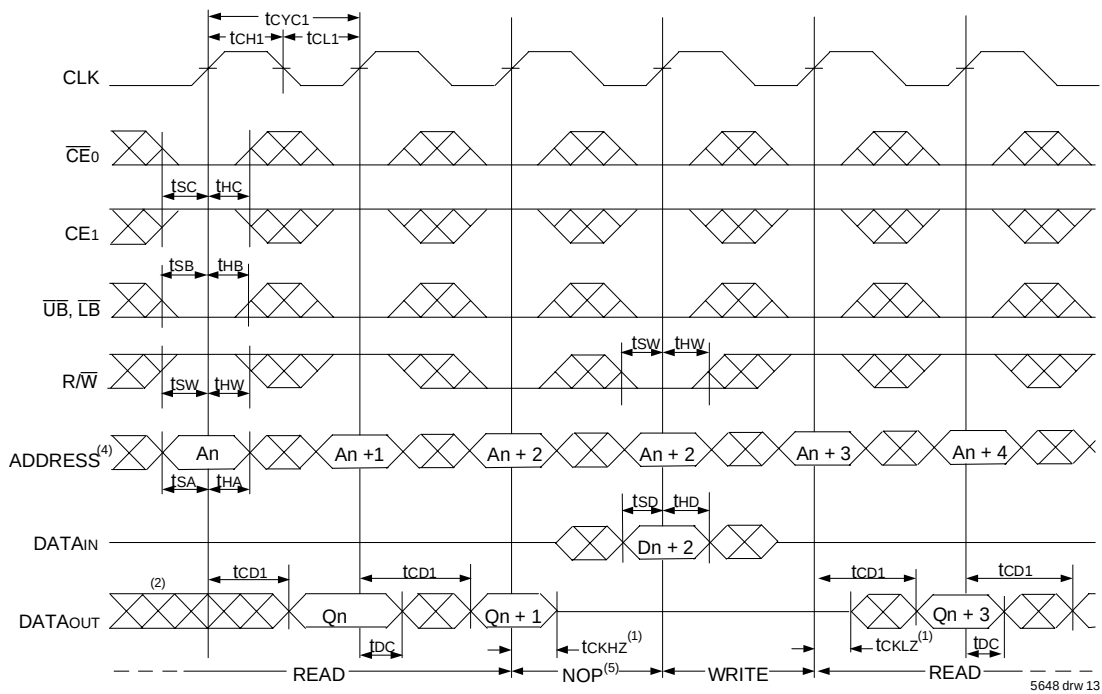
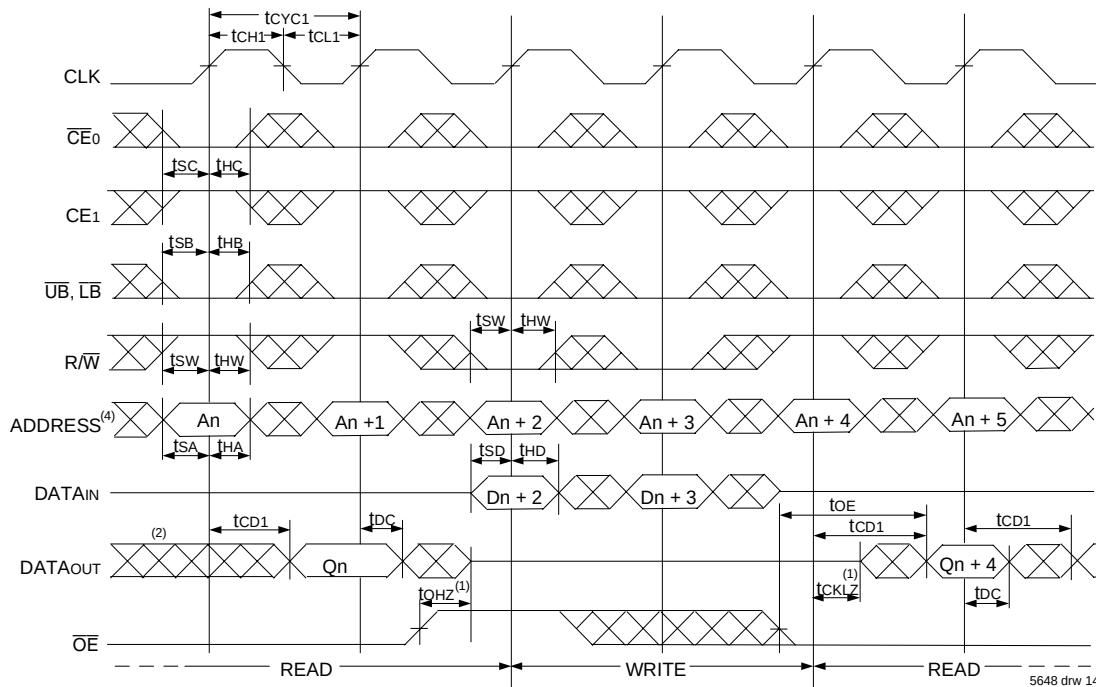


Timing Waveform of Pipelined Read-to-Write-to-Read ($\overline{\text{OE}}$ Controlled)⁽³⁾



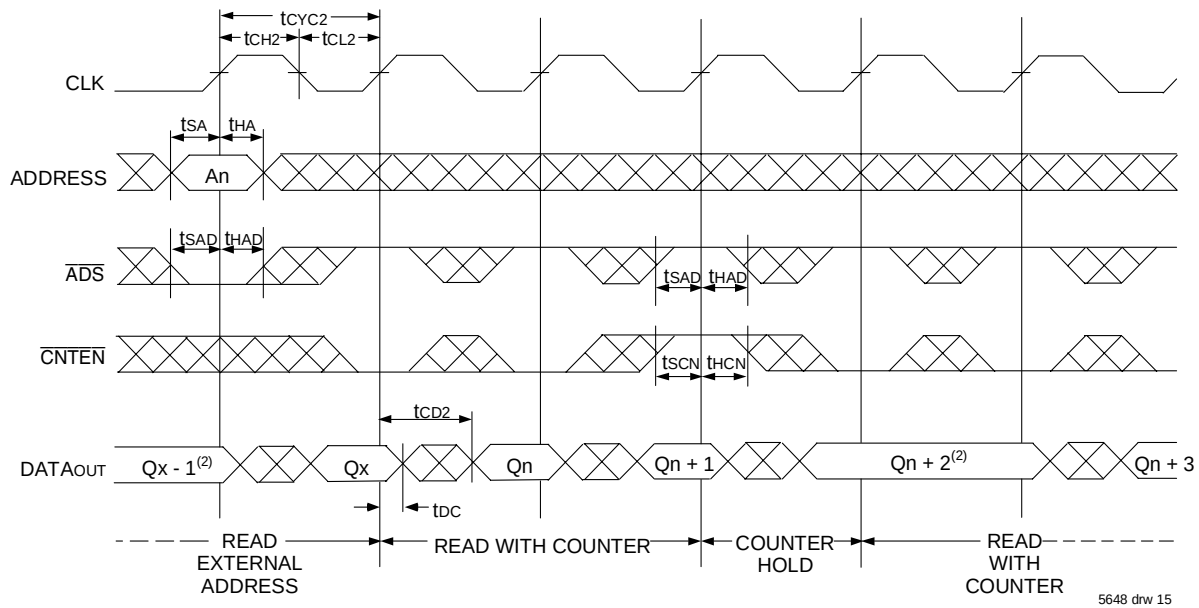
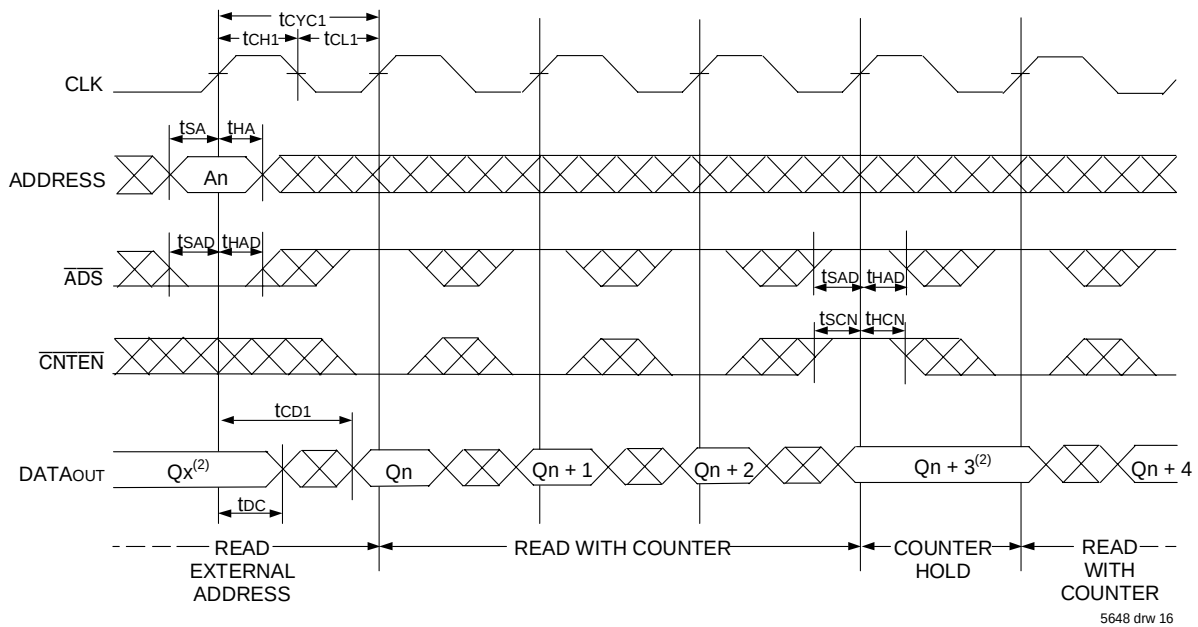
NOTES:

1. Transition is measured 0mV from Low or High-impedance voltage with the Output Test Load (Figure 2).
2. Output state (High, Low, or High-impedance) is determined by the previous cycle control signals.
3. $\overline{CE_0}$, $\overline{UB}$, $\overline{LB}$, and $\overline{ADS} = V_{IL}$; $\overline{CE_1}$, $\overline{CNTEN}$, and $\overline{CNTRST} = V_{IH}$. "NOP" is "No Operation".
4. 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 use only.
5. "NOP" is "No Operation." Data in memory at the selected address may be corrupted and should be re-written to guarantee data integrity.

Timing Waveform of Flow-Through Read-to-Write-to-Read ($\overline{OE} = V_{IL}$)⁽³⁾Timing Waveform of Flow-Through Read-to-Write-to-Read ($\overline{OE}$ Controlled)⁽³⁾

NOTES:

1. Transition is measured 0mV from Low or High-impedance voltage with the Output Test Load (Figure 2).
2. Output state (High, Low, or High-impedance) is determined by the previous cycle control signals.
3. $\overline{CE0}$, $\overline{UB}$, $\overline{LB}$, and $\overline{ADS} = V_{IL}$; $\overline{CE1}$, $\overline{CNTEN}$, and $\overline{CNTST} = V_{IH}$. "NOP" is "No Operation".
4. 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 use only.
5. "NOP" is "No Operation." Data in memory at the selected address may be corrupted and should be re-written to guarantee data integrity.

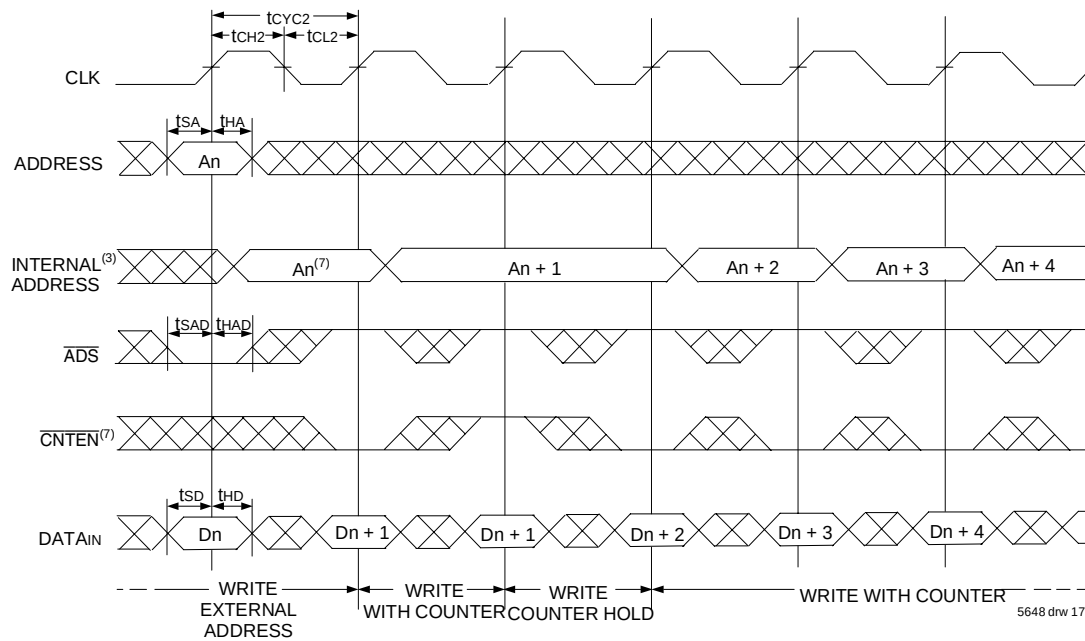
Timing Waveform of Pipelined Read with Address Counter Advance⁽¹⁾Timing Waveform of Flow-Through Read with Address Counter Advance⁽¹⁾

NOTES:

1. $\overline{CE_0}$, $\overline{OE}$, $\overline{UB}$, and $\overline{LB} = V_{IL}$; CE_1 , $R/\overline{W}$, and $\overline{CNTRST} = V_{IH}$.

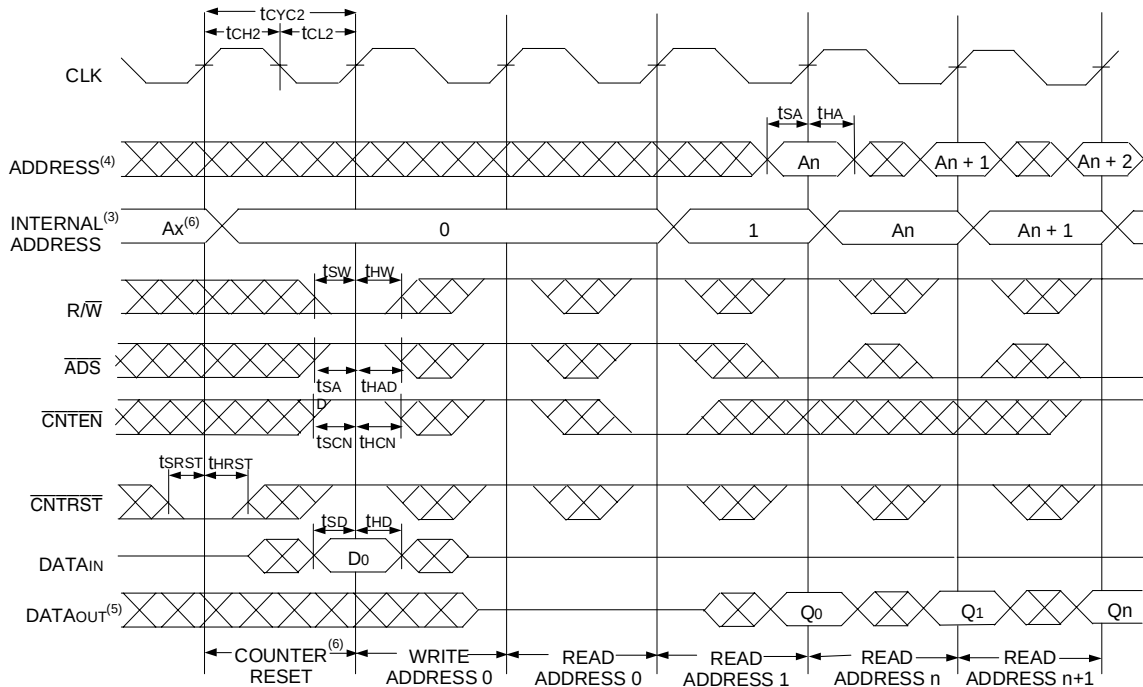
2. If there is no address change via $\overline{ADS} = V_{IL}$ (loading a new address) or $\overline{CNTEN} = V_{IL}$ (advancing the address), i.e. $\overline{ADS} = V_{IH}$ and $\overline{CNTEN} = V_{IH}$, then the data output remains constant for subsequent clocks.

Timing Waveform of Write with Address Counter Advance (Flow-Through or Pipelined Outputs)⁽¹⁾



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Timing Waveform of Counter Reset (Pipelined Outputs)⁽²⁾



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NOTES:

1. $\overline{CE_0}$, $\overline{UB}$, $\overline{LB}$, and $R/\overline{W}$ = V_{IL} ; CE_1 and $\overline{CNTRST}$ = V_{IH} .
2. $\overline{CE_0}$, $\overline{UB}$, $\overline{LB}$ = V_{IL} ; CE_1 = V_{IH} .
3. The "Internal Address" is equal to the "External Address" when $\overline{ADS}$ = V_{IL} and equals the counter output when $\overline{ADS}$ = V_{IH} .
4. 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 use only.
5. Output state (High, Low, or High-impedance) is determined by the previous cycle control signals.
6. No dead cycle exists during counter reset. A READ or WRITE cycle may be coincidental with the counter reset cycle. ADDR₀ will be accessed. Extra cycles are shown here simply for clarification.
7. $\overline{CNTEN}$ = V_{IL} advances Internal Address from 'An' to 'An +1'. The transition shown indicates the time required for the counter to advance. The 'An +1' Address is written to during this cycle.

Functional Description

The IDT70V9369 provides a true synchronous Dual-Port Static RAM interface. Registered inputs provide minimal set-up and hold times on address, data, and all critical control inputs. All internal registers are clocked on the rising edge of the clock signal, however, the self-timed internal write pulse is independent of the LOW to HIGH transition of the clock signal.

An asynchronous output enable is provided to ease asynchronous bus interfacing. Counter enable inputs are also provided to staff the operation of the address counters for fast interleaved memory applications.

$\overline{CE_0} = V_{IL}$ and $CE_1 = V_{IH}$ for one clock cycle will power down the internal circuitry to reduce static power consumption. Multiple chip enables allow easier banking of multiple IDT70V9369's for depth expansion configurations. When the Pipelined output mode is enabled, two cycles are required with $\overline{CE_0} = V_{IL}$ and $CE_1 = V_{IH}$ to re-activate the outputs.

Depth and Width Expansion

The IDT70V9369 features dual chip enables (refer to Truth Table I) in order to facilitate rapid and simple depth expansion with no requirements for external logic. Figure 4 illustrates how to control the various chip enables in order to expand two devices in depth.

The IDT70V9369 can also be used in applications requiring expanded width, as indicated in Figure 4. Since the banks are allocated at the discretion of the user, the external controller can be set up to drive the input signals for the various devices as required to allow for 36-bit or wider applications.

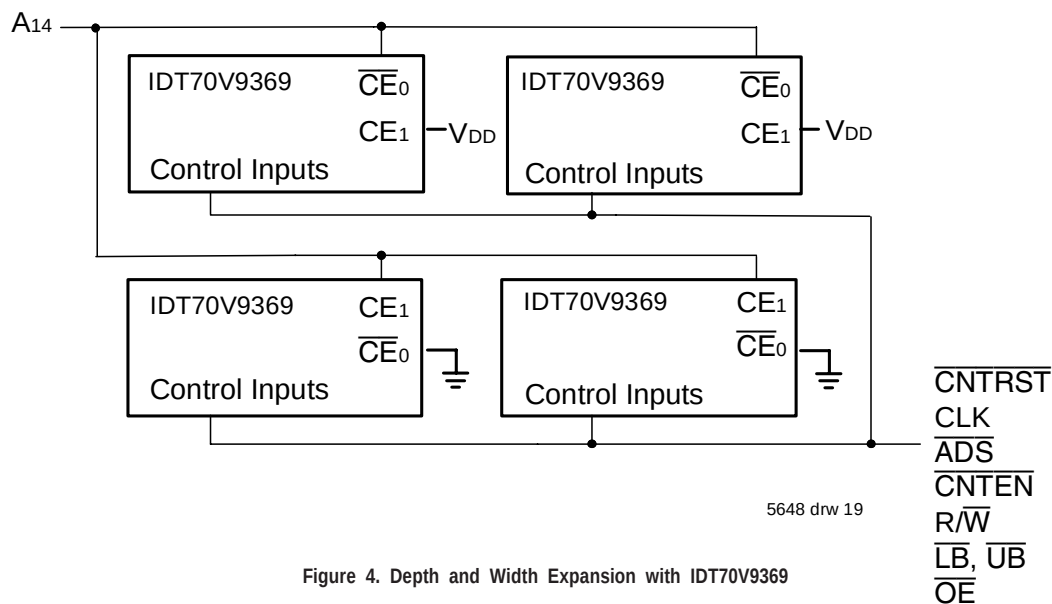


Figure 4. Depth and Width Expansion with IDT70V9369

Ordering Information

XXXXX	A	99	A	A		
Device Type	Power	Speed	Package	Process/ Temperature Range		
					Blank I (1)	Commercial (0°C to +70°C) Industrial (-40°C to +85°C)
					PF PRF	100-pin TQFP (PN100-1) x18 Only 128-pin TQFP (PK128) x 16 Only
					6 7 9 12	Commercial Only Commercial & Industrial Commercial Only Commercial Only
						} Speed in nanoseconds
					L	Low Power
					70V9369	288K (16K x 18-Bit) 3.3V Synchronous Dual-Port RAM

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NOTE:

1. Contact your local sales office for industrial temp range for other speeds, packages and powers.

Datasheet Document History

01/08/02:	Initial Public Release
10/11/04:	Removed "Preliminary" status
	Page 4 Updated Truth Table II
	Updated Absolute Maximum Ratings
	Updated Capacitance table
Page 5	Added 6ns speed grade and 7ns I-temp, removed 9ns I-temp and updated DC power numbers in the DC Electrical Characteristics Table
Page 7	Added 6ns speed grade and 7ns I-temp and removed 9ns I-temp AC timing numbers from the AC Electrical Characteristics Table
	Updated t _{OE} for 7ns and 9ns speed grades
Page 9	Added Timing Waveform of Left Port Write to Pipelined Right Port Read
Page 16	Added 6ns speed grade and 7ns I-temp and removed 9ns I-temp to ordering information
Page 1 & 16	Replaced old TM logo with new TM logo
10/23/08:	Page 16 Removed "IDT" from orderable part number



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