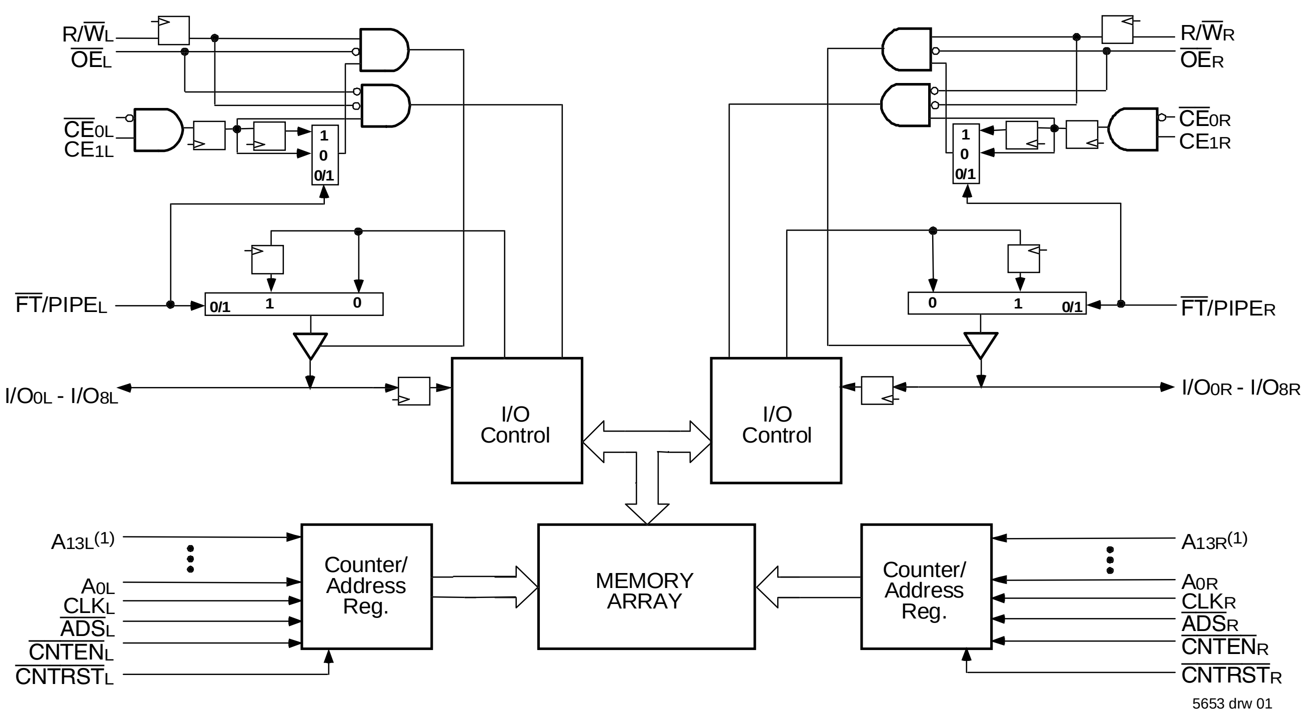
PRELIMINARY
IDT709169/59L

HIGH-SPEED 16/8K x 9 SYNCHRONOUS PIPELINED DUAL-PORT STATIC RAM

Features

- True Dual-Ported memory cells which allow simultaneous access of the same memory location
- High-speed clock to data access
  - *Commercial: 6.5/7.5/9ns (max.)*
    Industrial: 7.5ns (max.)
- Low-power operation
  - *IDT709169/59L*
    Active: 925mW (typ.)
    Standby: 2.5mW (typ.)
- Flow-Through or Pipelined output mode on either Port via the $\overline{FT}$/PIPE pins
- Counter enable and reset features
- Dual chip enables allow for depth expansion without additional logic
- Full synchronous operation on both ports
  - *3.5ns 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*
  - *10ns cycle time,100MHz operation in Pipelined output mode*
- TTL- compatible, single 5V (±10%) power supply
- Industrial temperature range (–40°C to +85°C) is available for 83MHz
- Available in a 100-pin Thin Quad Flatpack (TQFP) and 100-pin fine pitch Ball Grid Array (fpBGA) packages.

Functional Block Diagram



NOTE:
1. A_{13} is a NC for IDT709159.

JULY 2002

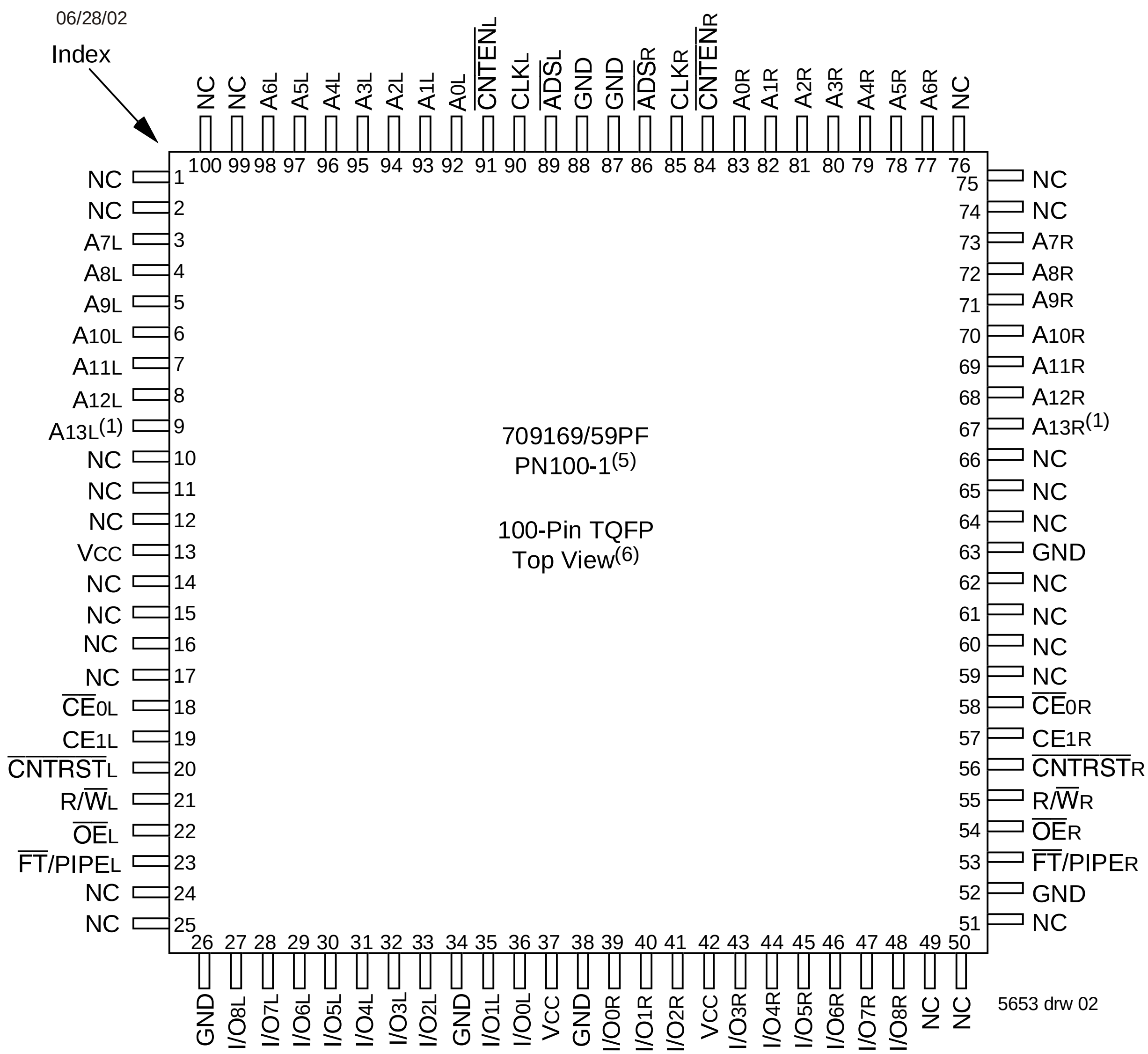
DSC-5653/1

Description

The IDT709169/59 is a high-speed 16/8K x 9 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 IDT709169/59 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 925mW of power.

Pin Configurations(1,2,3,4)



NOTES:
1. A13 is a NC for IDT709159.
2. All VCC pins must be connected to power supply.
3. All GND pins must be connected to ground supply.
4. Package body is approximately 14mm x 14mm x 1.4mm.
5. This package code is used to reference the package diagram.
6. This text does not indicate orientation of the actual part-marking.

Pin Configurations (con't.)[1,2,3,4]

709169/59BF
BF100[5]

100-Pin fpBGA
Top View[6]

06/28/02

A1 A_{6R}	A2 A_{9R}	A3 A_{12R}	A4 NC	A5 GND	A6 GND	A7 NC	A8 $R/\overline{W}_R$	A9 GND	A10 NC
B1 A_{4R}	B2 A_{5R}	B3 A_{8R}	B4 A_{10R}	B5 NC	B6 NC	B7 NC	B8 $\overline{OE}_R$	B9 NC	B10 I/O_{6R}
C1 A_{3R}	C2 NC	C3 NC	C4 A_{7R}	C5 NC	C6 $\overline{CE}_{0R}$	C7 CE_{1R}	C8 $PL/\overline{FT}_R$	C9 I/O_{7R}	C10 I/O_{3R}
D1 A_{0R}	D2 CLK_R	D3 A_{1R}	D4 A_{2R}	D5 A_{11R}	D6 A_{13R}(1)	D7 $\overline{CNTRST}_R$	D8 I/O_{8R}	D9 I/O_{5R}	D10 I/O_{1R}
E1 GND	E2 $\overline{ADS}_R$	E3 $\overline{CNTEN}_R$	E4 A_{1L}	E5 $\overline{ADS}_L$	E6 GND	E7 I/O_{4R}	E8 I/O_{2R}	E9 I/O_{0R}	E10 V_{CC}
F1 GND	F2 CLK_L	F3 A_{0L}	F4 A_{3L}	F5 V_{CC}	F6 GND	F7 V_{CC}	F8 I/O_{2L}	F9 I/O_{1L}	F10 I/O_{0L}
G1 $\overline{CNTEN}_L$	G2 NC	G3 A_{5L}	G4 A_{12L}	G5 NC	G6 $R/\overline{W}_L$	G7 NC	G8 I/O_{4L}	G9 GND	G10 I/O_{3L}
H1 A_{2L}	H2 A_{4L}	H3 A_{9L}	H4 A_{13L}(1)	H5 NC	H6 CE_{1L}	H7 NC	H8 I/O_{7L}	H9 I/O_{6L}	H10 I/O_{5L}
J1 NC	J2 A_{7L}	J3 A_{10L}	J4 NC	J5 NC	J6 NC	J7 $\overline{OE}_L$	J8 GND	J9 GND	J10 I/O_{8L}
K1 A_{6L}	K2 A_{8L}	K3 A_{11L}	K4 NC	K5 V_{CC}	K6 V_{CC}	K7 $\overline{CE}_{0L}$	K8 $\overline{CNTRST}_L$	K9 $PL/\overline{FT}_L$	K10 NC

5653 drw 03

NOTES:
1. A_{13} is a NC for IDT709159.
2. All V_{CC} pins must be connected to power supply.
3. All GND pins must be connected to ground supply.
4. Package body is approximately 10mm x 10mm x 1.4mm with 0.8mm ball pitch.
5. This package code is used to reference the package diagram.
6. 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
$R/\overline{W}_L$	$R/\overline{W}_R$	Read/Write Enable
$\overline{OE}_L$	$\overline{OE}_R$	Output Enable
A_{0L} - A_{13L}[1]	A_{0R} - A_{13R}[1]	Address
I/O_{0L} - I/O_{8L}	I/O_{0R} - I/O_{8R}	Data Input/Output
CLK_L	CLK_R	Clock
$\overline{ADS}_L$	$\overline{ADS}_R$	Address Strobe
$\overline{CNTEN}_L$	$\overline{CNTEN}_R$	Counter Enable
$\overline{CNTRST}_L$	$\overline{CNTRST}_R$	Counter Reset
$\overline{FT}/PIPE_L$	$\overline{FT}/PIPE_R$	Flow-Through/Pipeline
V_{CC}		Power (5V)
GND		Ground (0V)

5653 tbl 01

NOTE:
1. A_{13} is a NC for IDT709159.

Truth Table I—Read/Write and Enable Control[1,2,3]

$\overline{OE}$	CLK	$\overline{CE}_0$	CE_1	$R/\overline{W}$	I/O_{0-8}	Mode
X	↑	H	X	X	High-Z	Deselected—Power Down
X	↑	X	L	X	High-Z	Deselected—Power Down
X	↑	L	H	L	$DATA_{IN}$	Write
L	↑	L	H	H	$DATA_{OUT}$	Read
H	X	L	H	X	High-Z	Outputs Disabled

5653 tbl 02

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

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

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

5653 tbl 03

NOTES:
1. "H" = VIH, "L" = VIL, "X" = Don't Care.
2. $\overline{CE_0}$ and $\overline{OE}$ = VIL; CE1 and R/$\overline{W}$ = VIH.
3. Outputs configured in Flow-Through Output mode: if outputs are in Pipelined mode the data out will be delayed by one cycle.
4. $\overline{ADS}$ and $\overline{CNTRST}$ are independent of all other signals including $\overline{CE_0}$ and CE1.
5. The address counter advances if $\overline{CNTEN}$ = VIL on the rising edge of CLK, regardless of all other signals including $\overline{CE_0}$ and CE1.

Recommended Operating Temperature and Supply Voltage

Grade	Ambient Temperature(1)	GND	Vcc
Commercial	0°C to +70°C	0V	5.0V ± 10%
Industrial	-40°C to +85°C	0V	5.0V ± 10%

5653 tbl 04

NOTES:
1. This is the parameter TA. This is the "instant on" case temperature.

Recommended DC Operating Conditions

Symbol	Parameter	Min.	Typ.	Max.	Unit
VCC	Supply Voltage	4.5	5.0	5.5	V
GND	Ground	0	0	0	V
VIH	Input High Voltage	2.2	—	6.0(1)	V
VIL	Input Low Voltage	-0.5(2)	—	0.8	V

5653 tbl 05

NOTES:
1. VTERM must not exceed Vcc + 10%.
2. VIL ≥ -1.5V for pulse width less than 10ns.

Absolute Maximum Ratings(1)

Symbol	Rating	Commercial & Industrial	Unit
VTERM(2)	Terminal Voltage with Respect to GND	-0.5 to +7.0	V
TBIAS	Temperature Under Bias	-55 to +125	°C
TSTG	Storage Temperature	-65 to +150	°C
IOUT	DC Output Current	50	mA

5653 tbl 06

NOTES:
1. 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.
2. VTERM must not exceed Vcc + 10% for more than 25% of the cycle time or 10ns maximum, and is limited to ≤ 20mA for the period of VTERM ≥ Vcc + 10%.

Capacitance(1)

(TA = +25°C, f = 1.0MHz)

Symbol	Parameter	Conditions(2)	Max.	Unit
CIN	Input Capacitance	VIN = 3dV	9	pF
COUT(3)	Output Capacitance	VOUT = 3dV	10	pF

5653 tbl 07

NOTES:
1. These parameters are determined by device characterization, but are not production tested.
2. 3dV references the interpolated capacitance when the input and output switch from 0V to 3V or from 3V to 0V.
3. COUT also references CI/O.

DC Electrical Characteristics Over the Operating Temperature Supply Voltage Range (V_{CC} = 5.0V ± 10%)

Symbol	Parameter	Test Conditions	709169/59L Min.	709169/59L Max.	Unit
$\|I_{LI}\|$	Input Leakage Current(1)	V_{CC} = 5.5V, V_{IN} = 0V to V_{CC}	—	5	µA
$\|I_{LO}\|$	Output Leakage Current	$\overline{CE}_0$ = V_{IH} or CE_1 = V_{IL}, V_{OUT} = 0V to V_{CC}	—	5	µA
V_{OL}	Output Low Voltage	I_{OL} = +4mA	—	0.4	V
V_{OH}	Output High Voltage	I_{OH} = -4mA	2.4	—	V

5653 tbl 08

NOTE:
1. At $V_{CC} \leq$ 2.0V input leakages are undefined.

DC Electrical Characteristics Over the Operating Temperature and Supply Voltage Range(3) (V_{CC} = 5V ± 10%)

Symbol	Parameter	Test Condition	Version	709169/59L6 Com'l Only		709169/59L7 Com'l & Ind		709169/59L9 Com'l Only		Unit
				Typ.(4)	Max.	Typ.(4)	Max.	Typ.(4)	Max.	
I_{CC}	Dynamic Operating Current (Both Ports Active)	$\overline{CE}_L$ and $\overline{CE}_R$= V_{IL} Outputs Disabled f = f_{MAX}(1)	COM'L L	230	430	210	400	185	360	mA
			IND L	—	—	210	440	—	—	
I_{SB1}	Standby Current (Both Ports - TTL Level Inputs)	$\overline{CE}_L$ = $\overline{CE}_R$ = V_{IH} f = f_{MAX}(1)	COM'L L	45	115	40	105	35	95	mA
			IND L	—	—	40	120	—	—	
I_{SB2}	Standby Current (One Port - TTL Level Inputs)	$\overline{CE}_{"A"}$ = V_{IL} and $\overline{CE}_{"B"}$ = V_{IH}(3) Active Port Outputs Disabled, f=f_{MAX}(1)	COM'L L	150	235	135	220	120	205	mA
			IND L	—	—	135	235	—	—	
I_{SB3}	Full Standby Current (Both Ports - CMOS Level Inputs)	Both Ports CE_R and $\overline{CE}_L \geq V_{CC}$ - 0.2V $V_{IN} \geq V_{CC}$ - 0.2V or $V_{IN} \leq$ 0.2V, f = 0(2)	COM'L L	0.5	3.0	0.5	3.0	0.5	3.0	mA
			IND L	—	—	0.5	3.0	—	—	
I_{SB4}	Full Standby Current (One Port - CMOS Level Inputs)	$\overline{CE}_{"A"} \leq$ 0.2V and $\overline{CE}_{"B"} \geq V_{CC}$ - 0.2V(5) $V_{IN} \geq V_{CC}$ - 0.2V or $V_{IN} \leq$ 0.2V, Active Port Outputs Disabled, f = f_{MAX}(1)	COM'L L	160	210	130	190	110	170	mA
			IND L	—	—	130	205	—	—	

5653 tbl 09

NOTES:
1. At f = f_{MAX}, address and control lines (except Output Enable) are cycling at the maximum frequency clock cycle of 1/t_{CYC}, using "AC TEST CONDITIONS" at input levels of GND to 3V.
2. f = 0 means no address, clock, or control lines change. Applies only to input at CMOS level standby.
3. Port "A" may be either left or right port. Port "B" is the opposite from port "A".
4. V_{CC} = 5V, T_A = 25°C for Typ, and are not production tested. $I_{CC\,DC}$(f=0) = 150mA (Typ).
5. CE_X = V_{IL} means $\overline{CE}_{0X}$ = V_{IL} and CE_{1X} = V_{IH}
   CE_X = V_{IH} means $\overline{CE}_{0X}$ = V_{IH} or CE_{1X} = V_{IL}
   $CE_X \leq$ 0.2V means $\overline{CE}_{0X} \leq$ 0.2V and $CE_{1X} \geq V_{CC}$ - 0.2V
   $CE_X \geq V_{CC}$ - 0.2V means $\overline{CE}_{0X} \geq V_{CC}$ - 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	2ns Max.
Input Timing Reference Levels	1.5V
Output Reference Levels	1.5V
Output Load	Figures 1, 2 and 3

5653 tbl 10

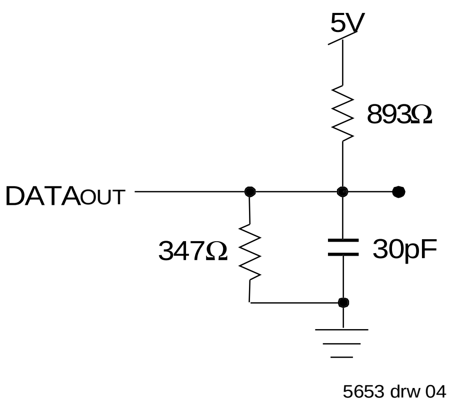


Figure 1. AC Output Test load.

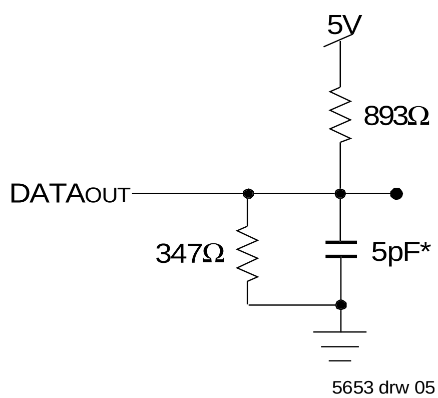


Figure 2. Output Test Load
(For t_{CKLZ}, t_{CKHZ}, t_{OLZ}, and t_{OHZ}).
*Including scope and jig.

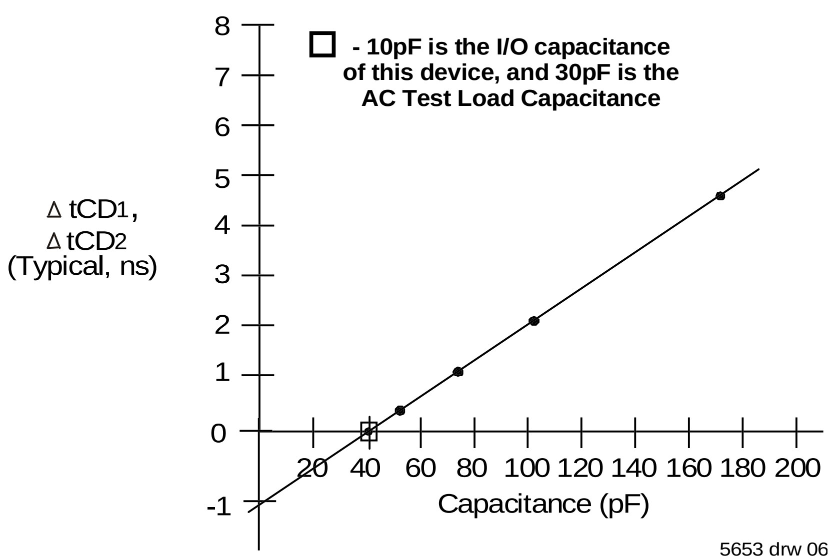


Figure 3. Typical Output Derating (Lumped Capacitive Load).

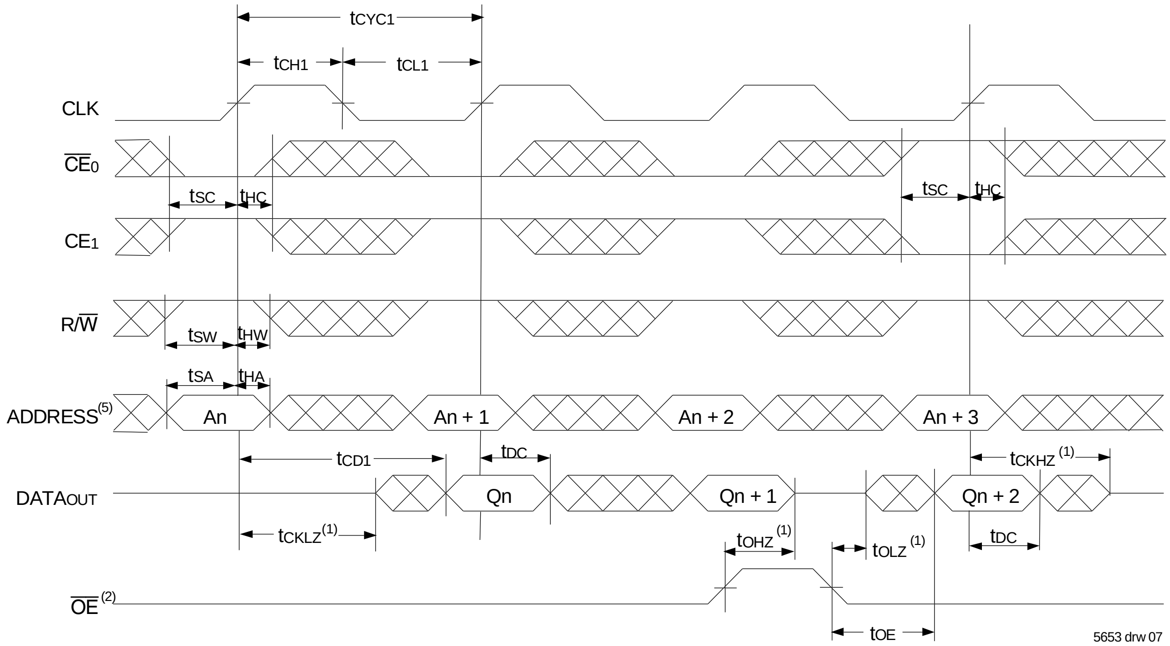
AC Electrical Characteristics Over the Operating Temperature Range (Read and Write Cycle Timing)(3) (Vcc = 5V ± 10%, TA = 0°C to +70°C)

		709169/59L6 Com'l Only		709169/59L7 Com'l & Ind		709169/59L9 Com'l Only		
Symbol	Parameter	Min.	Max.	Min.	Max.	Min.	Max.	Unit
t_{CYC1}	Clock Cycle Time (Flow-Through)(2)	19	—	22	—	25	—	ns
t_{CYC2}	Clock Cycle Time (Pipelined)(2)	10	—	12	—	15	—	ns
t_{CH1}	Clock High Time (Flow-Through)(2)	6.5	—	7.5	—	12	—	ns
t_{CL1}	Clock Low Time (Flow-Through)(2)	6.5	—	7.5	—	12	—	ns
t_{CH2}	Clock High Time (Pipelined)(2)	4	—	5	—	6	—	ns
t_{CL2}	Clock Low Time (Pipelined)(2)	4	—	5	—	6	—	ns
t_R	Clock Rise Time	—	3	—	3	—	3	ns
t_F	Clock Fall Time	—	3	—	3	—	3	ns
t_{SA}	Address Setup Time	3.5	—	4	—	4	—	ns
t_{HA}	Address Hold Time	0	—	0	—	1	—	ns
t_{SC}	Chip Enable Setup Time	3.5	—	4	—	4	—	ns
t_{HC}	Chip Enable Hold Time	0	—	0	—	1	—	ns
t_{SB}	Byte Enable Setup Time	3.5	—	4	—	4	—	ns
t_{HB}	Byte Enable Hold Time	0	—	0	—	1	—	ns
t_{SW}	R/$\overline{W}$ Setup Time	3.5	—	4	—	4	—	ns
t_{HW}	R/$\overline{W}$ Hold Time	0	—	0	—	1	—	ns
t_{SD}	Input Data Setup Time	3.5	—	4	—	4	—	ns
t_{HD}	Input Data Hold Time	0	—	0	—	1	—	ns
t_{SAD}	$\overline{ADS}$ Setup Time	3.5	—	4	—	4	—	ns
t_{HAD}	$\overline{ADS}$ Hold Time	0	—	0	—	1	—	ns
t_{SCN}	$\overline{CNTEN}$ Setup Time	3.5	—	4	—	4	—	ns
t_{HCN}	$\overline{CNTEN}$ Hold Time	0	—	0	—	1	—	ns
t_{SRST}	$\overline{CNTRST}$ Setup Time	3.5	—	4	—	4	—	ns
t_{HRST}	$\overline{CNTRST}$ Hold Time	0	—	0	—	1	—	ns
t_{OE}	Output Enable to Data Valid	—	6.5	—	7.5	—	9	ns
t_{OLZ}	Output Enable to Output Low-Z(1)	2	—	2	—	2	—	ns
t_{OHZ}	Output Enable to Output High-Z(1)	1	7	1	7	1	7	ns
t_{CD1}	Clock to Data Valid (Flow-Through)(2)	—	15	—	18	—	20	ns
t_{CD2}	Clock to Data Valid (Pipelined)(2)	—	6.5	—	7.5	—	9	ns
t_{DC}	Data Output Hold After Clock High	2	—	2	—	2	—	ns
t_{CKHZ}	Clock High to Output High-Z(1)	2	9	2	9	2	9	ns
t_{CKLZ}	Clock High to Output Low-Z(1)	2	—	2	—	2	—	ns
Port-to-Port Delay								
t_{CWDD}	Write Port Clock High to Read Data Delay	—	24	—	28	—	35	ns
t_{CCS}	Clock-to-Clock Setup Time	—	9	—	10	—	15	ns

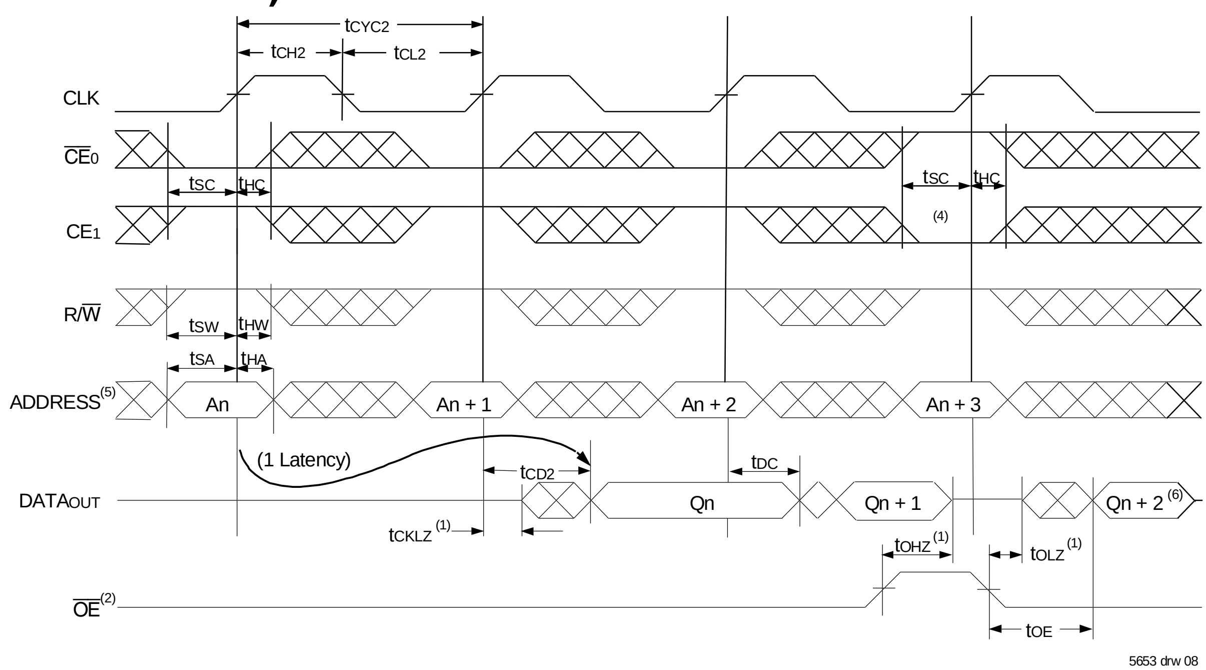
5653 tbl 11

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 (t_{CYC2}, t_{CD2}) to either the Left or Right ports when $\overline{FT}$/PIPE = V_{IH}. Flow-Through parameters (t_{CYC1}, t_{CD1}) 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 ($\overline{FT}$/PIPE"X" = V_{IL})[3,6]



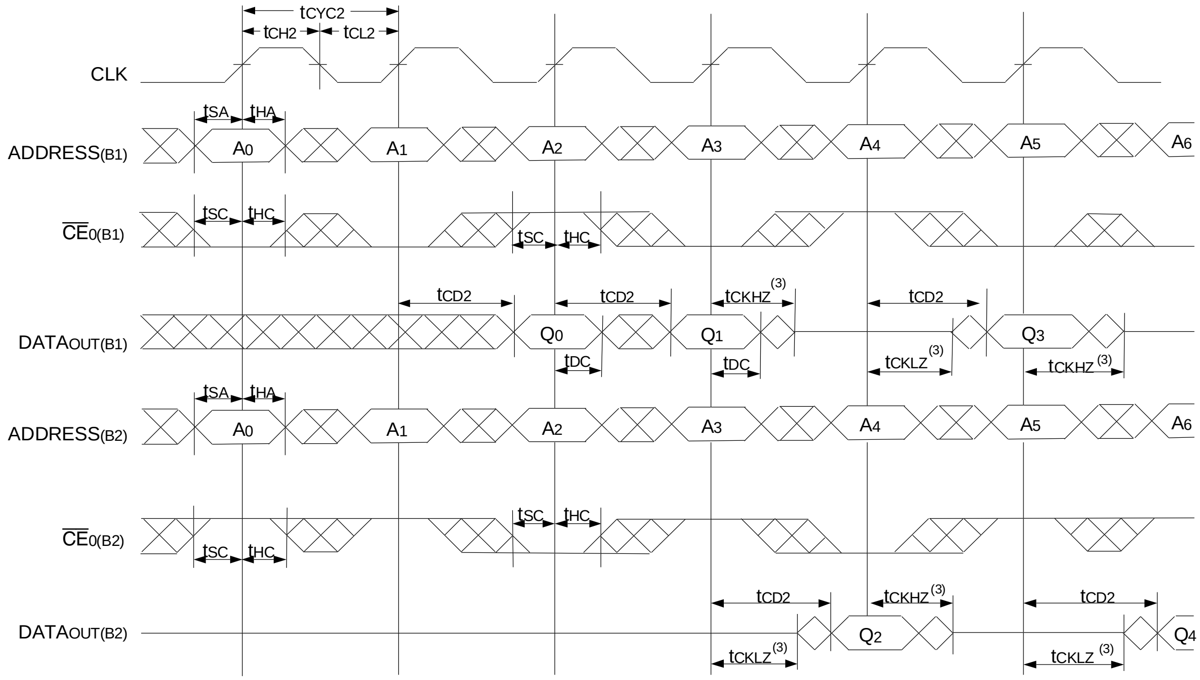
Timing Waveform of Read Cycle for Pipelined Operation ($\overline{FT}$/PIPE"X" = V_{IH})[3,6]



NOTES:

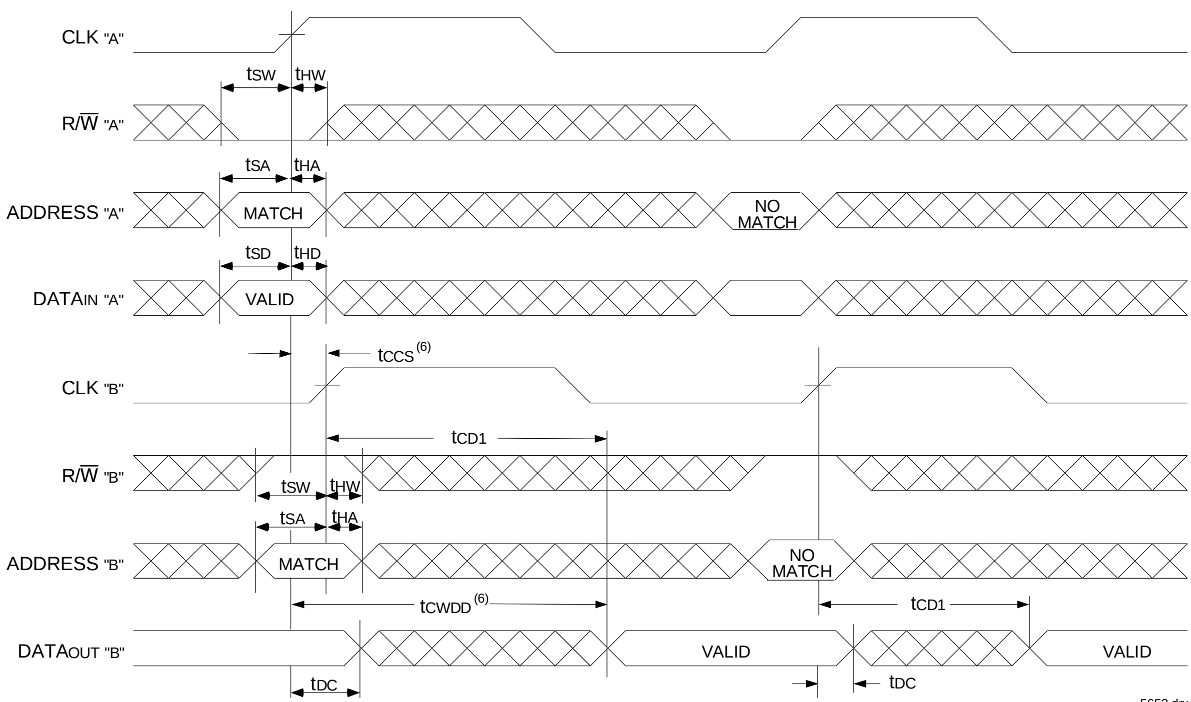
1. Transition is measured 0mV from Low or High-impedance voltage with the Output Test Load (Figure 2).
2. $\overline{OE}$ is asynchronously controlled; all other inputs are synchronous to the rising clock edge.
3. $\overline{ADS}$ = V_{IL}, $\overline{CNTEN}$ and $\overline{CNTRST}$ = V_{IH}.
4. The output is disabled (High-Impedance state) by $\overline{CE_0}$ = V_{IH} or CE_1 = V_{IL} following the next rising edge of the clock. Refer to Truth Table 1.
5. 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.
6. "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]



5653 drw 09

Timing Waveform of Write with Port-to-Port Flow-Through Read[4,5,7]



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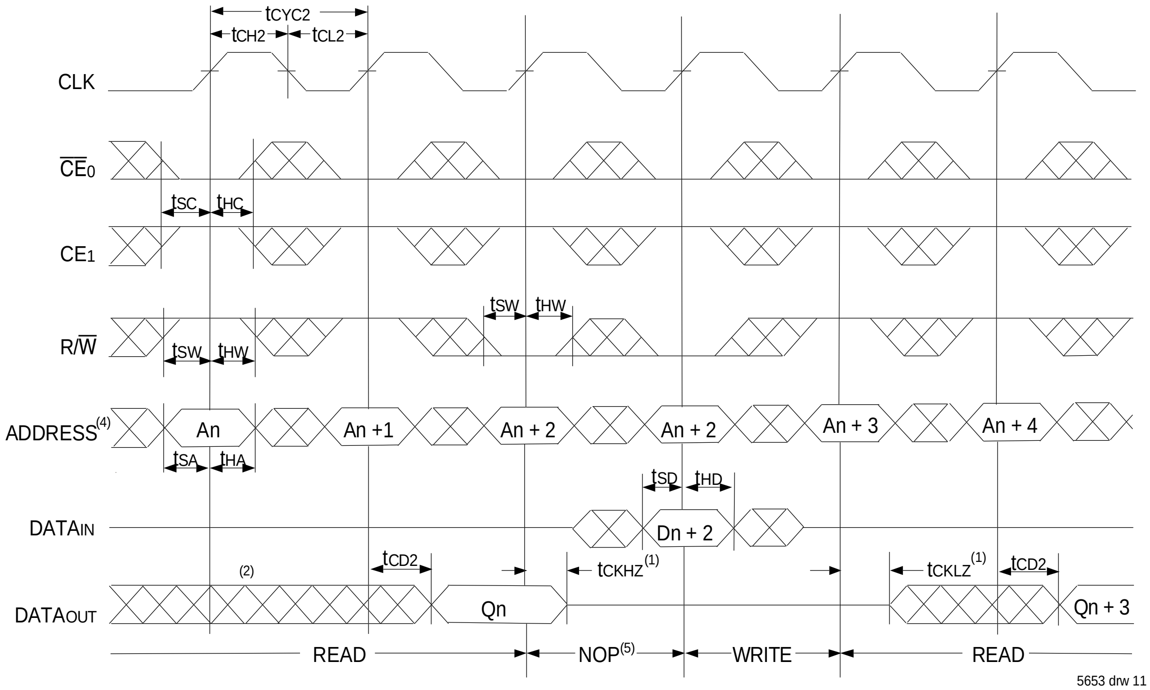
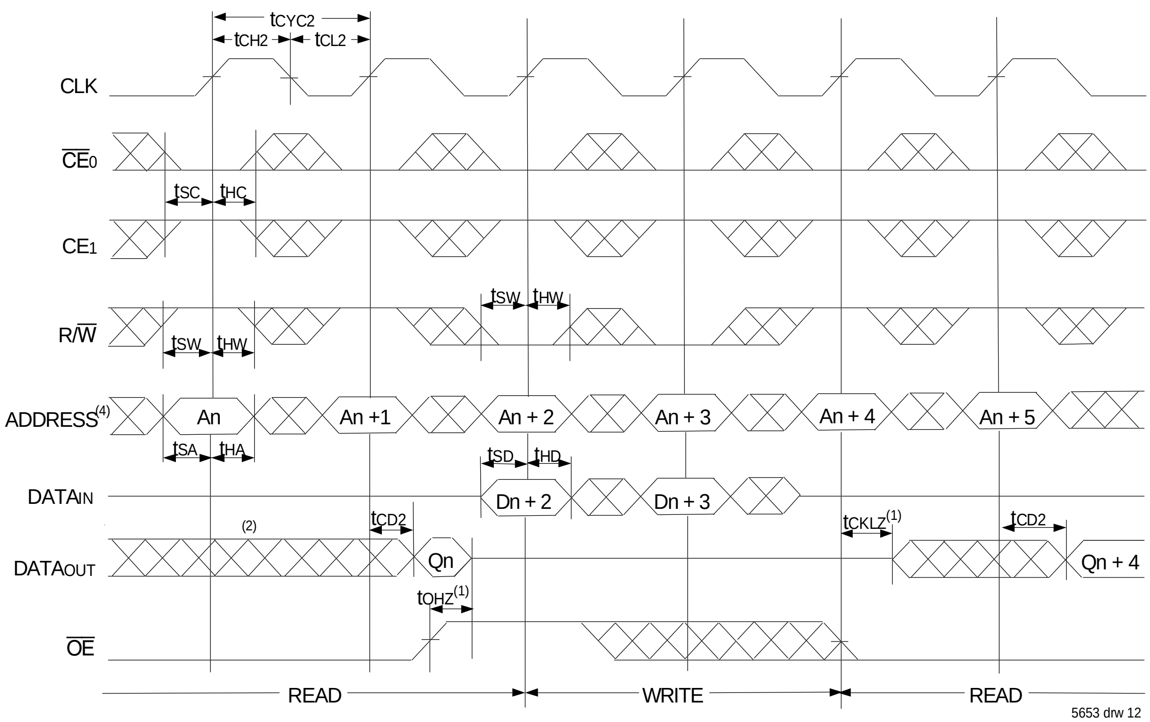
NOTES:

1. B1 Represents Bank #1; B2 Represents Bank #2. Each Bank consists of one IDT709169/59 for this waveform, and are setup for depth expansion in this example. ADDRESS(B1) = ADDRESS(B2) in this situation.
2. $\overline{OE}$ and $\overline{ADS}$ = V_{IL}; $CE_{1(B1)}$, $CE_{1(B2)}$, R/$\overline{W}$, $\overline{CNTEN}$, and $\overline{CNTRST}$ = V_{IH}.
3. Transition is measured 0mV from Low or High-impedance voltage with the Output Test Load (Figure 2).
4. $\overline{CE_0}$ 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_{CWDD}.
   If t_{CCS} > maximum specified, then data from right port READ is not valid until t_{CCS} + t_{CD1}. t_{CWDD} 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 ($\overline{OE}$ = VIL)(3)

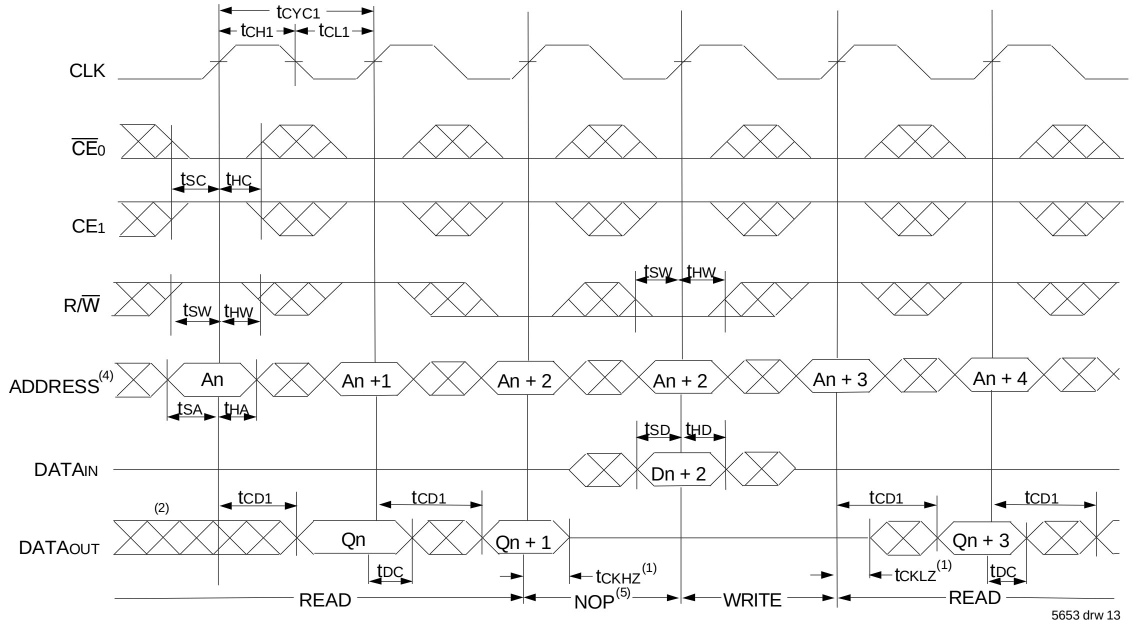


Timing Waveform of Pipelined Read-to-Write-to-Read ($\overline{OE}$ Controlled)(3)

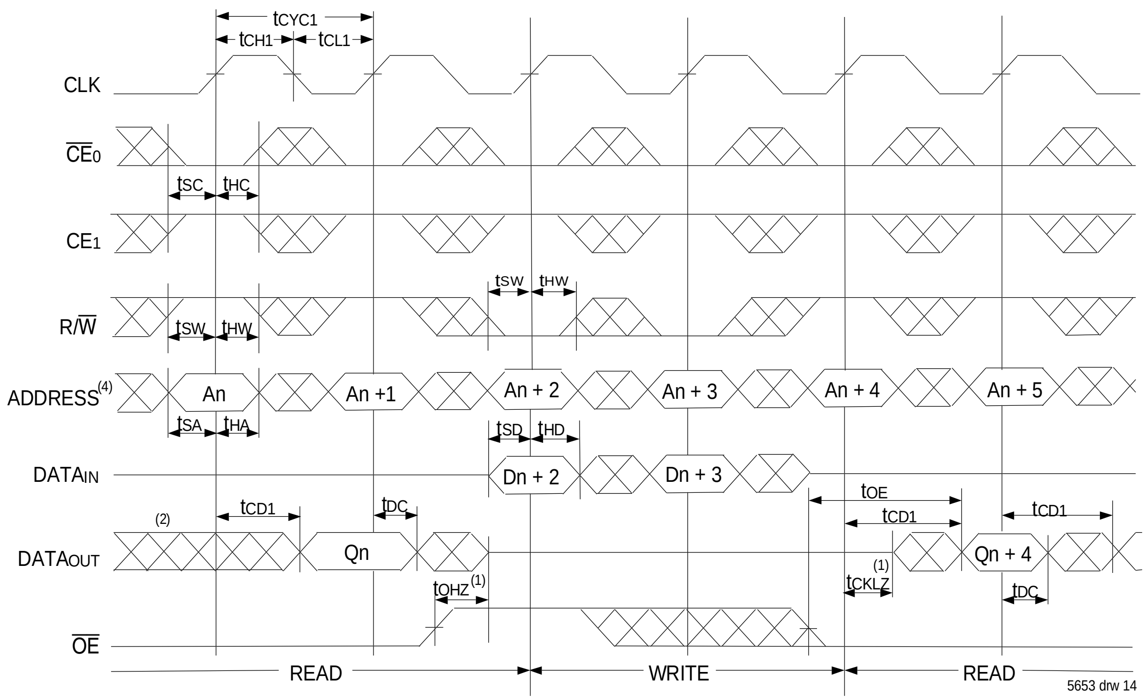


NOTES:
1. Transition is measured 0mV from Low or High-impedance voltage with the Output Test Load (Figure 2).
2. Output state (High, Low, or High-impedance) is determined by the previous cycle control signals.
3. $\overline{CE_0}$ and $\overline{ADS}$ = VIL; CE1, $\overline{CNTEN}$, and $\overline{CNTRST}$ = VIH. "NOP" is "No Operation".
4. Addresses do not have to be accessed sequentially since $\overline{ADS}$ = VIL 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 ($\overline{OE}$ = VIL)(3)

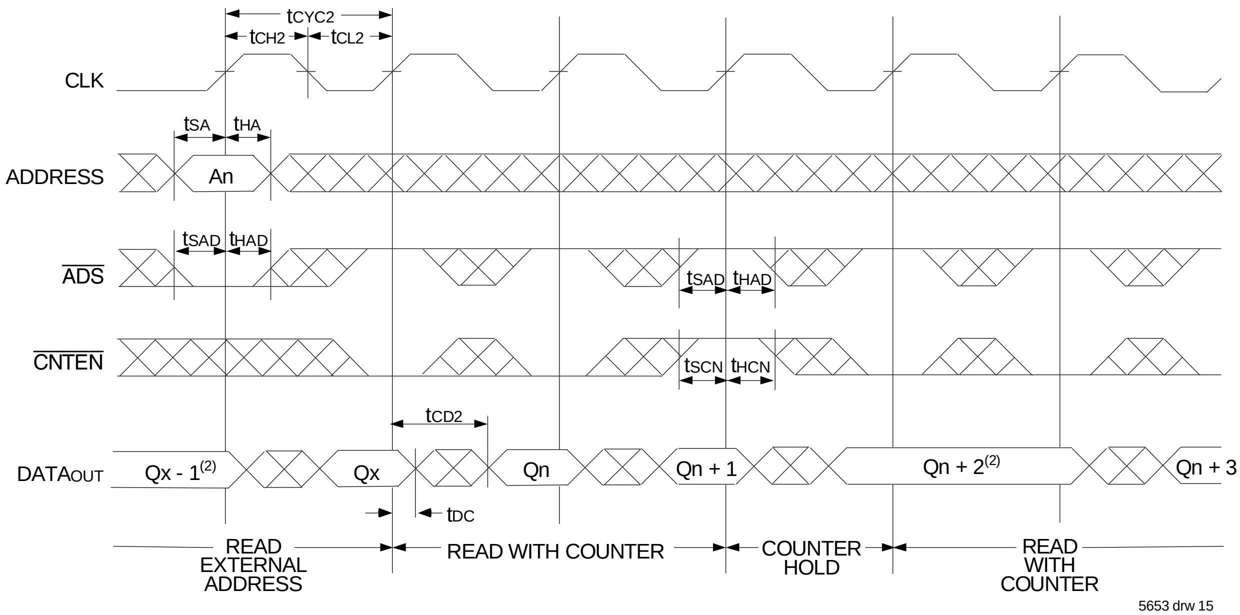


Timing Waveform of Flow-Through Read-to-Write-to-Read ($\overline{OE}$ Controlled)(3)

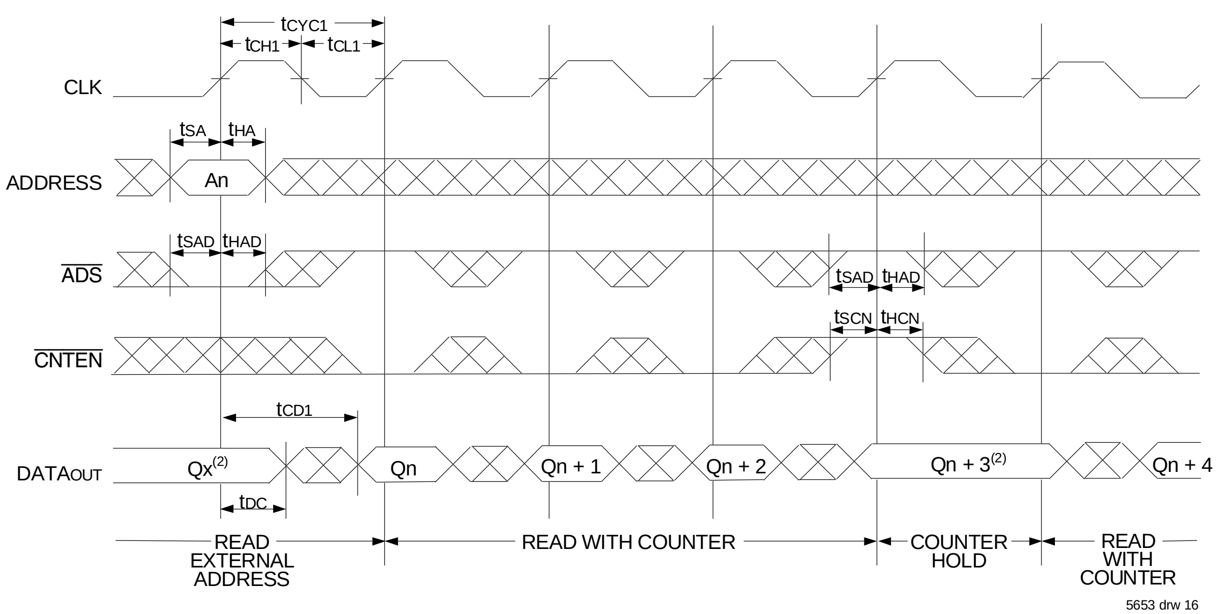


NOTES:
1. Transition is measured 0mV from Low or High-impedance voltage with the Output Test Load (Figure 2).
2. Output state (High, Low, or High-impedance is determined by the previous cycle control signals.
3. $\overline{CE_0}$ and $\overline{ADS}$ = VIL; CE1, $\overline{CNTEN}$, and $\overline{CNTRST}$ = VIH. "NOP" is "No Operation".
4. Addresses do not have to be accessed sequentially since $\overline{ADS}$ = VIL 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)

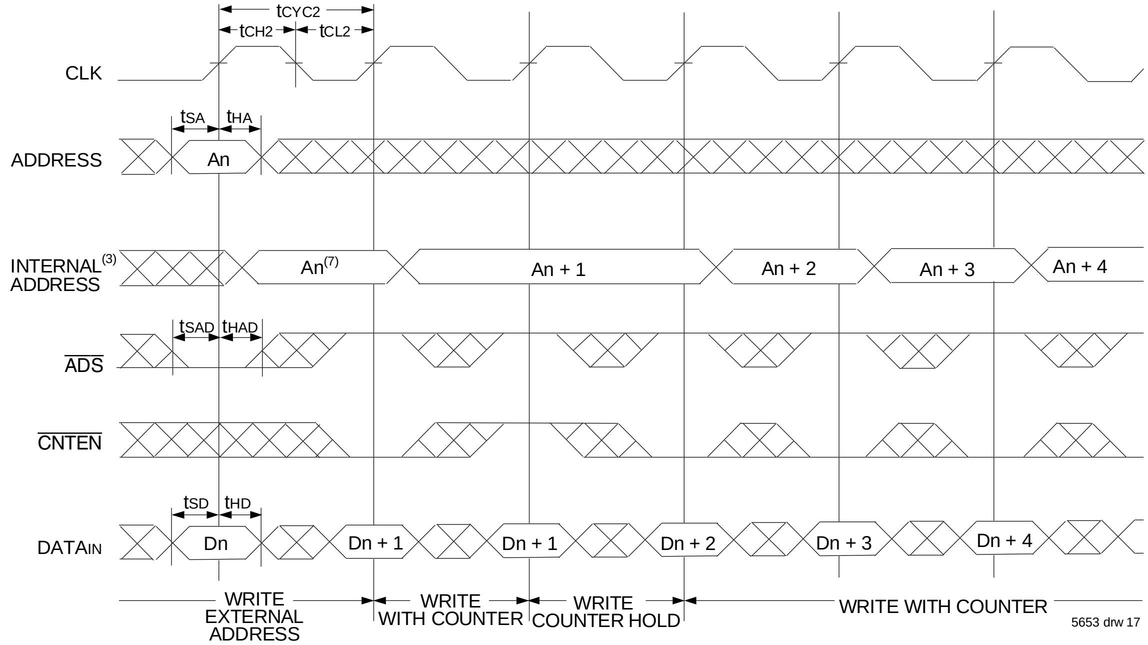


Timing Waveform of Flow-Through Read with Address Counter Advance(1)

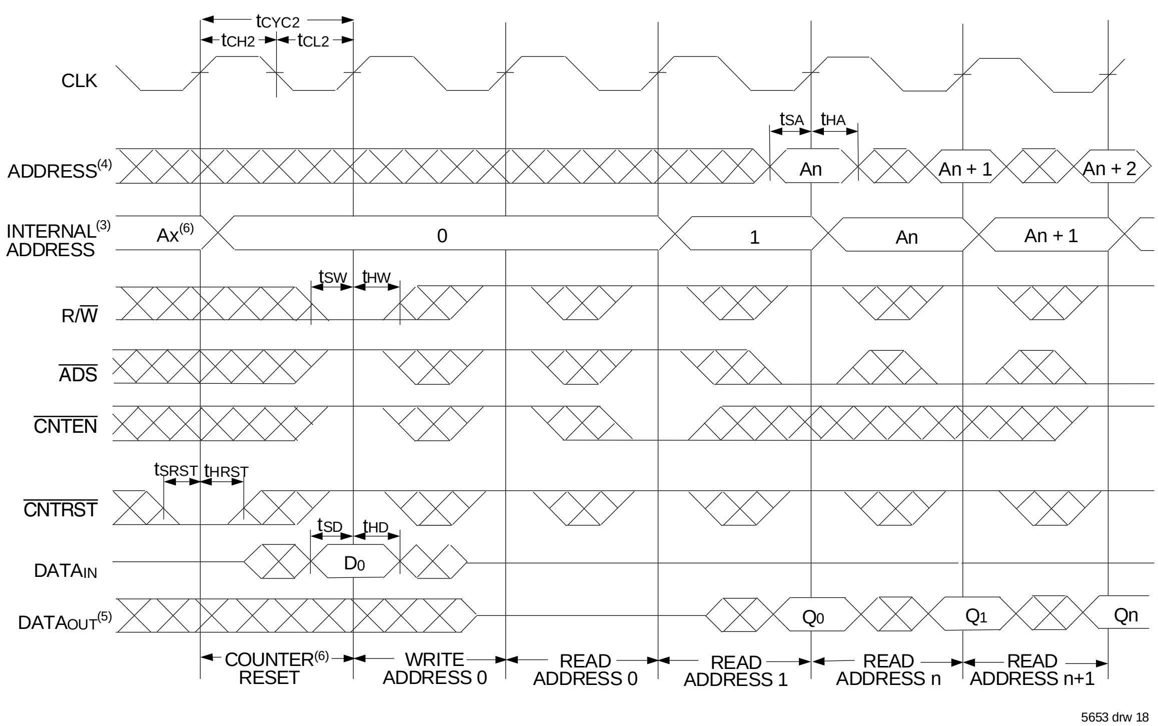


NOTES:
1. $\overline{CE_0}$ and $\overline{OE}$ = V_{IL}, CE_1, R/$\overline{W}$, and $\overline{CNTRST}$ = V_{IH}.
2. If there is no address change via $\overline{ADS}$ = V_{IL} (loading a new address) or $\overline{CNTEN}$ = V_{IL} (advancing the address), i.e. $\overline{ADS}$ = V_{IH} and $\overline{CNTEN}$ = 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)



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



NOTES:
1. $\overline{CE}_0$ and $R/\overline{W} = V_{IL}$; CE_1 and $\overline{CNTRST} = V_{IH}$.
2. $\overline{CE}_0 = V_{IL}$; $CE_1 = V_{IH}$.
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.
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.

A Functional Description

The IDT709169/59 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 stall the operation of the address counters for fast interleaved memory applications.

$\overline{CE}_0 = V_{IH}$ or $CE_1 = V_{IL}$ for one clock cycle will power down the internal circuitry to reduce static power consumption. Multiple chip enables allow easier banking of multiple IDT709169/59's for depth expansion configurations. When the Pipelined output mode is enabled, two cycles are required to get valid data on the outputs.

Depth and Width Expansion

The IDT709169/59 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 IDT709169/59 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 18-bit or wider applications.

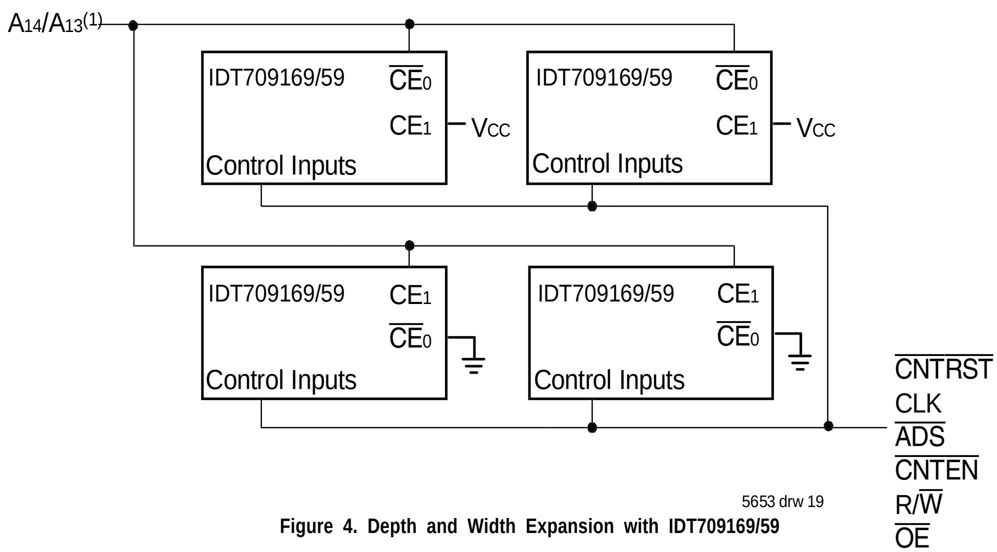


Figure 4. Depth and Width Expansion with IDT709169/59

NOTE:
1. A_{14} is for IDT709169, A_{13} is for IDT709159.

Ordering Information

IDT XXXXX A 99 A A

- XXXXX — Device Type
- A — Power
- 99 — Speed
- A — Package
- A — Process/Temperature Range

Process/Temperature Range

Blank	Commercial (0°C to +70°C)
I[(1)]	Industrial (-40°C to +85°C)

Package

PF	100-pin TQFP (PN100-1)
BF	100-pin fpBGA (BF100)

Speed (Speed in nanoseconds)

6	Commercial Only
7	Commercial & Industrial
9	Commercial Only

Power

L	Low Power

Device Type

709169	144K (16K x 9-Bit) Synchronous Dual-Port RAM
709159	72K (8K x 9- Bit) Synchronous Dual-Port RAM

5653 drw 20

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

Datasheet Document History

07/08/02: Initial Public Release

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