



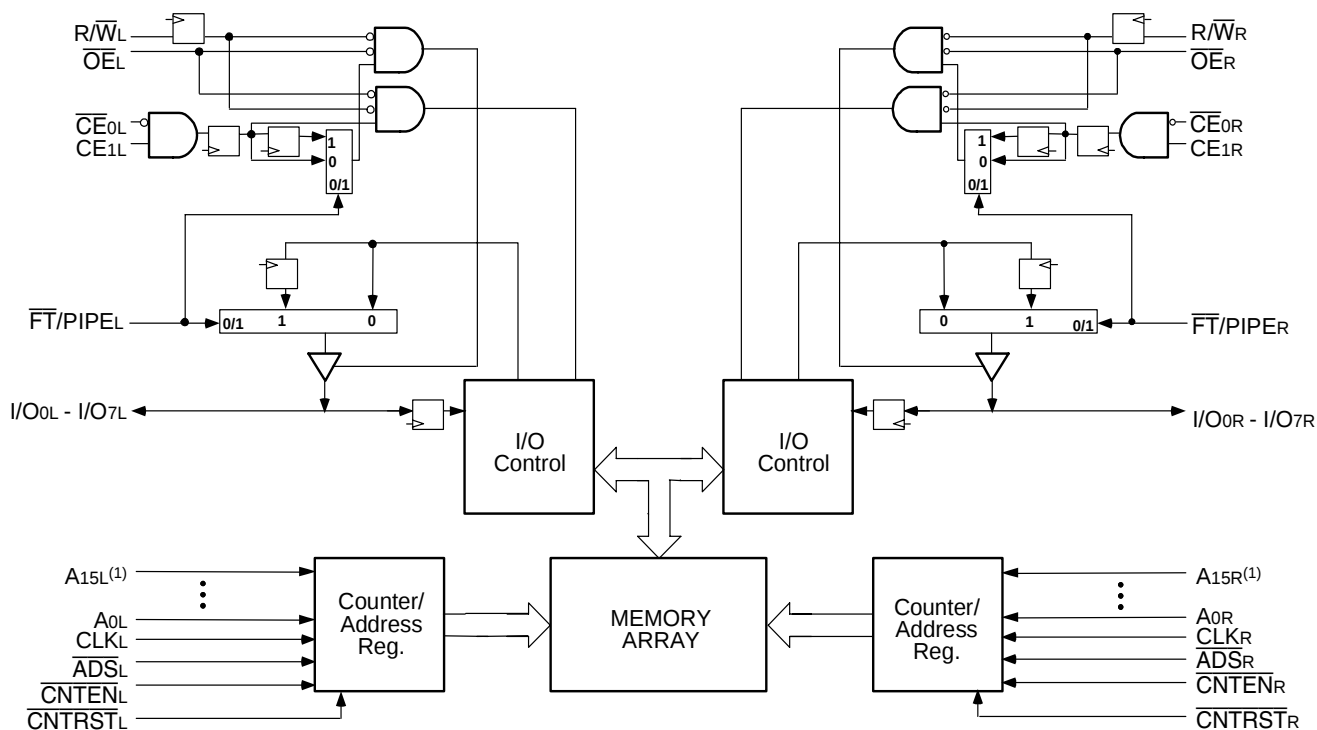
# HIGH-SPEED 64/32K x 8 SYNCHRONOUS DUAL-PORT STATIC RAM

**IDT709089/79S/L**

## Features:

- ♦ **True Dual-Ported** memory cells which allow simultaneous access of the same memory location
- ♦ **High-speed clock to data access**
  - Commercial: 9/12/15ns (max.)
  - Industrial: 12ns (max.)
- ♦ **Low-power operation**
  - IDT709089/79S  
Active: 950mW (typ.)  
Standby: 5mW (typ.)
  - IDT709089/79L  
Active: 950mW (typ.)  
Standby: 1mW (typ.)
- ♦ **Flow-Through or Pipelined output mode on either port via the  $\overline{\text{FT}}/\text{PIPE}$  pin**
- ♦ **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 1ns hold on all control, data, and address inputs
  - Data input, address, and control registers
  - Fast 9ns clock to data out in the Pipelined output mode
  - Self-timed write allows fast cycle time
  - 15ns cycle time, 66.7MHz operation in the Pipelined output mode
- ♦ **TTL-compatible, single 5V ( $\pm 10\%$ ) power supply**
- ♦ **Industrial temperature range ( $-40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$ ) is available for selected speeds**
- ♦ **Available in 100-pin Thin Quad Flatpack (TQFP) package**
- ♦ **Green parts available, see ordering information**

## Functional Block Diagram



3242 drw 01

## NOTE:

1. A15x is a NC for IDT709079.

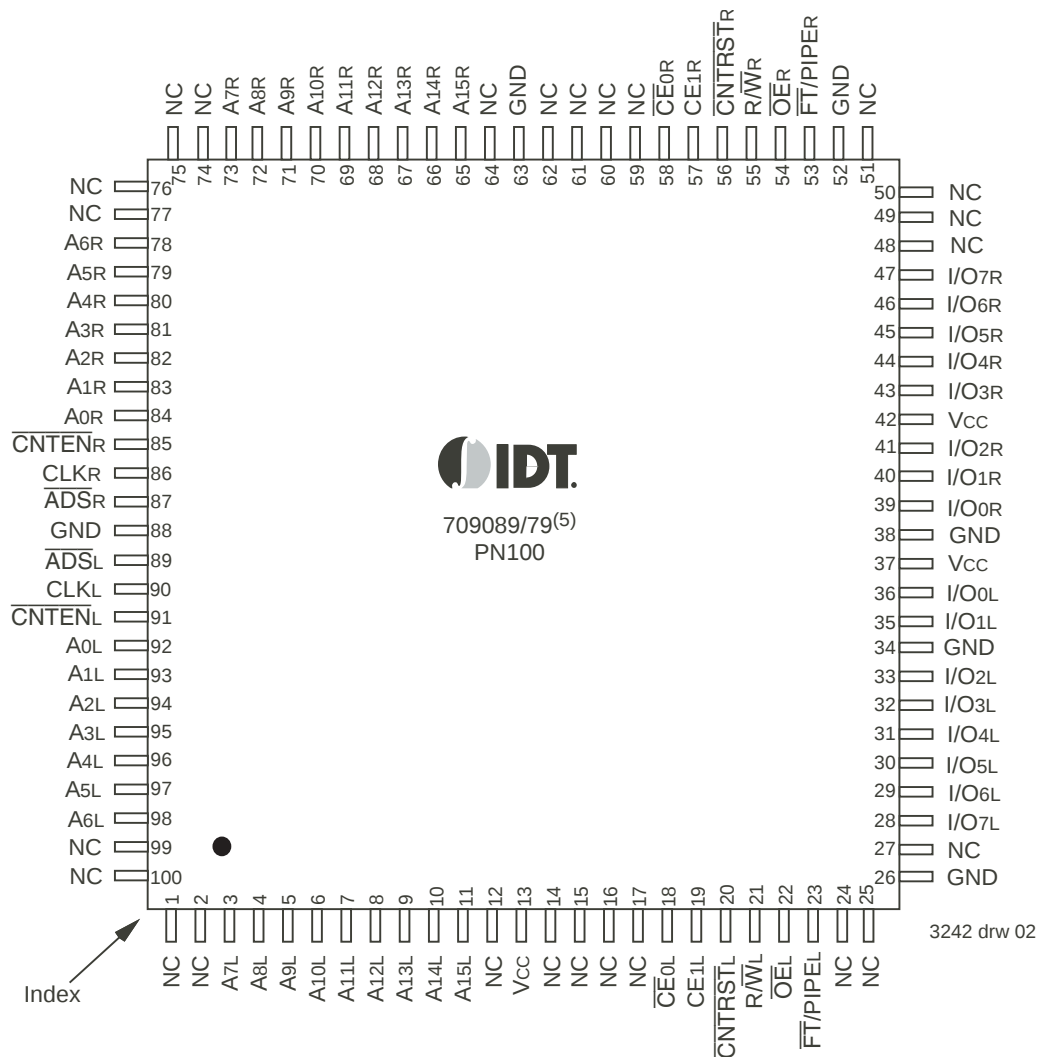
FEBRUARY 2016

## Description:

The IDT709089/79 is a high-speed 64/32K x 8 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 IDT709089/79 has been optimized for applications having unidirectional or bidirectional data flow in bursts. An automatic power down feature, controlled by  $\overline{CE}0$  and  $CE1$ , permits the on-chip circuitry of each port to enter a very low standby power mode. Fabricated using CMOS high-performance technology, these devices typically operate on only 950mW of power.

## Pin Configuration<sup>(1,2,3)</sup>



### NOTES:

1. A15x is a NC for IDT709079.
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.

## 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         |
| $A_{0L}$ - $A_{15L}^{(1)}$       | $A_{0R}$ - $A_{15R}^{(1)}$       | Address               |
| $I/O_{0L}$ - $I/O_{7L}$          | $I/O_{0R}$ - $I/O_{7R}$          | Data Input/Output     |
| $CLK_L$                          | $CLK_R$                          | Clock                 |
| $\overline{ADS}_L$               | $\overline{ADS}_R$               | Address Strobe        |
| $\overline{CNTEN}_L$             | $\overline{CNTEN}_R$             | Counter Enable        |
| $\overline{CNRST}_L$             | $\overline{CNRST}_R$             | Counter Reset         |
| $\overline{FT}/PIPE_L$           | $\overline{FT}/PIPE_R$           | Flow-Through/Pipeline |
| Vcc                              |                                  | Power                 |
| GND                              |                                  | Ground                |

3242 tbl 01

### NOTE:

1.  $A_{15x}$  is a NC for IDT709079.

## Truth Table I— Read/Write and Enable Control<sup>(1,2,3)</sup>

| $\overline{OE}$ | CLK | $\overline{CE}_0$ | $CE_1$ | $R/\overline{W}$ | $I/O_{0-7}$ | Mode             |
|-----------------|-----|-------------------|--------|------------------|-------------|------------------|
| X               | ↑   | H                 | X      | X                | High-Z      | Deselected       |
| X               | ↑   | X                 | L      | X                | High-Z      | Deselected       |
| X               | ↑   | L                 | H      | L                | DIN         | Write            |
| L               | ↑   | L                 | H      | H                | DOUT        | Read             |
| H               | X   | L                 | H      | X                | High-Z      | Outputs Disabled |

3242 tbl 02

### NOTES:

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

## Truth Table II—Address Counter Control<sup>(1,2)</sup>

| External Address | Previous Internal Address | Internal Address Used | CLK | $\overline{ADS}$ | $\overline{CNTEN}$ | $\overline{CNRST}$ | $I/O^{(3)}$    | MODE                                                          |
|------------------|---------------------------|-----------------------|-----|------------------|--------------------|--------------------|----------------|---------------------------------------------------------------|
| $A_n$            | X                         | $A_n$                 | ↑   | $L^{(4)}$        | X                  | H                  | $D_{i/o}(n)$   | External Address Used                                         |
| X                | $A_n$                     | $A_n + 1$             | ↑   | H                | $L^{(5)}$          | H                  | $D_{i/o}(n+1)$ | Counter Enabled—Internal Address generation                   |
| X                | $A_n + 1$                 | $A_n + 1$             | ↑   | H                | H                  | H                  | $D_{i/o}(n+1)$ | External Address Blocked—Counter disabled ( $A_n + 1$ reused) |
| X                | X                         | $A_0$                 | ↑   | X                | X                  | $L^{(4)}$          | $D_{i/o}(0)$   | Counter Reset to Address 0                                    |

5640 tbl 03

### NOTES:

1. "H" =  $V_{IH}$ , "L" =  $V_{IL}$ , "X" = Don't Care.
2.  $\overline{CE}_0$  and  $\overline{OE}$  =  $V_{IL}$ ;  $CE_1$  and  $R/\overline{W}$  =  $V_{IH}$ .
3. Outputs configured in Flow-Through Output mode; if outputs are in Pipelined mode the data out will be delayed by one cycle.
4.  $\overline{ADS}$  is independent of all other signals including  $\overline{CE}_0$  and  $CE_1$ .
5. The address counter advances if  $\overline{CNTEN}$  =  $V_{IL}$  on the rising edge of CLK, regardless of all other signals including  $\overline{CE}_0$  and  $CE_1$ .

## Recommended Operating Temperature and Supply Voltage<sup>(1)</sup>

| Grade      | Ambient Temperature | GND | V <sub>CC</sub> |
|------------|---------------------|-----|-----------------|
| Commercial | 0°C to +70°C        | 0V  | 5.0V $\pm$ 10%  |
| Industrial | -40°C to +85°C      | 0V  | 5.0V $\pm$ 10%  |

3242 tbl 04

### NOTES:

1. This is the parameter T<sub>A</sub>. This is the "instant on" case temperature.

## Recommended DC Operating Conditions

| Symbol          | Parameter          | Min.                | Typ. | Max.               | Unit |
|-----------------|--------------------|---------------------|------|--------------------|------|
| V <sub>CC</sub> | Supply Voltage     | 4.5                 | 5.0  | 5.5                | V    |
| GND             | Ground             | 0                   | 0    | 0                  | V    |
| V <sub>IH</sub> | Input High Voltage | 2.2                 | —    | 6.0 <sup>(1)</sup> | V    |
| V <sub>IL</sub> | Input Low Voltage  | -0.5 <sup>(2)</sup> | —    | 0.8                | V    |

3242 tbl 05

### NOTES:

1. V<sub>TERM</sub> must not exceed V<sub>CC</sub> + 10%.
2. V<sub>IL</sub>  $\geq$  -1.5V for pulse width less than 10ns.

## Absolute Maximum Ratings<sup>(1)</sup>

| Symbol                           | Rating                               | Commercial & Industrial | Unit |
|----------------------------------|--------------------------------------|-------------------------|------|
| V <sub>TERM</sub> <sup>(2)</sup> | Terminal Voltage with Respect to GND | -0.5 to +7.0            | V    |
| T <sub>BIAS</sub>                | Temperature Under Bias               | -55 to +125             | °C   |
| T <sub>STG</sub>                 | Storage Temperature                  | -65 to +150             | °C   |
| T <sub>JN</sub>                  | Junction Temperature                 | +150                    | °C   |
| I <sub>OUT</sub>                 | DC Output Current                    | 50                      | mA   |

3242 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. V<sub>TERM</sub> must not exceed V<sub>CC</sub> + 10% for more than 25% of the cycle time or 10ns maximum, and is limited to  $\leq$  20mA for the period of V<sub>TERM</sub>  $\geq$  V<sub>CC</sub> + 10%.
3. Ambient Temperature Under DC Bias. No AC Conditions. Chip Deselected.

## Capacitance<sup>(1)</sup>

(T<sub>A</sub> = +25°C, f = 1.0MHz)

| Symbol                          | Parameter          | Conditions <sup>(2)</sup> | Max. | Unit |
|---------------------------------|--------------------|---------------------------|------|------|
| C <sub>IN</sub>                 | Input Capacitance  | V <sub>IN</sub> = 3dV     | 9    | pF   |
| C <sub>OUT</sub> <sup>(3)</sup> | Output Capacitance | V <sub>OUT</sub> = 3dV    | 10   | pF   |

3242 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. C<sub>OUT</sub> also references C<sub>I/O</sub>.

## DC Electrical Characteristics Over the Operating Temperature and Supply Voltage Range (V<sub>CC</sub> = 5.0V $\pm$ 10%)

| Symbol          | Parameter                            | Test Conditions                                                                                            | 709089/79S/L |      | Unit |
|-----------------|--------------------------------------|------------------------------------------------------------------------------------------------------------|--------------|------|------|
|                 |                                      |                                                                                                            | Min.         | Max. |      |
| I <sub>L</sub>  | Input Leakage Current <sup>(1)</sup> | V <sub>CC</sub> = 5.5V, V <sub>IN</sub> = 0V to V <sub>CC</sub>                                            | —            | 10   | μA   |
| I <sub>LO</sub> | Output Leakage Current               | $\overline{CE}_0 = V_{IH}$ or CE <sub>1</sub> = V <sub>IL</sub> , V <sub>OUT</sub> = 0V to V <sub>CC</sub> | —            | 10   | μA   |
| V <sub>OL</sub> | Output Low Voltage                   | I <sub>OL</sub> = +4mA                                                                                     | —            | 0.4  | V    |
| V <sub>OH</sub> | Output High Voltage                  | I <sub>OH</sub> = -4mA                                                                                     | 2.4          | —    | V    |

3242 tbl 08

### NOTE:

1. At V<sub>CC</sub>  $\leq$  2.0V input leakages are undefined.

## DC Electrical Characteristics Over the Operating Temperature and Supply Voltage Range<sup>(6)</sup> ( $V_{CC} = 5V \pm 10\%$ )

| Symbol | Parameter                                                | Test Condition                                                                                                                                                                              | Version |   | 709089/79X9<br>Com'l Only |      | 709089/79X12<br>Com'l & Ind |      | 709089/79X15<br>Com'l Only |      | Unit |
|--------|----------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|---|---------------------------|------|-----------------------------|------|----------------------------|------|------|
|        |                                                          |                                                                                                                                                                                             |         |   | Typ. <sup>(4)</sup>       | Max. | Typ. <sup>(4)</sup>         | Max. | Typ. <sup>(4)</sup>        | Max. |      |
| ICC    | Dynamic Operating Current<br>(Both Ports Active)         | $\overline{CE}_L$ and $\overline{CE}_R = V_{IL}$<br>Outputs Disabled<br>$f = f_{MAX}^{(1)}$                                                                                                 | COM'L   | S | 210                       | 390  | 200                         | 345  | 190                        | 325  | mA   |
|        |                                                          |                                                                                                                                                                                             |         | L | 210                       | 350  | 200                         | 305  | 190                        | 285  |      |
|        |                                                          |                                                                                                                                                                                             | IND     | S | —                         | —    | 200                         | 380  | —                          | —    |      |
|        |                                                          |                                                                                                                                                                                             |         | L | —                         | —    | 200                         | 340  | —                          | —    |      |
| ISB1   | Standby Current<br>(Both Ports - TTL Level Inputs)       | $\overline{CE}_L = \overline{CE}_R = V_{IH}$<br>$f = f_{MAX}^{(1)}$                                                                                                                         | COM'L   | S | 50                        | 135  | 50                          | 110  | 50                         | 110  | mA   |
|        |                                                          |                                                                                                                                                                                             |         | L | 50                        | 115  | 50                          | 90   | 50                         | 90   |      |
|        |                                                          |                                                                                                                                                                                             | IND     | S | —                         | —    | 50                          | 125  | —                          | —    |      |
|        |                                                          |                                                                                                                                                                                             |         | L | —                         | —    | 50                          | 105  | —                          | —    |      |
| ISB2   | Standby Current<br>(One Port - TTL Level Inputs)         | $\overline{CE}^*A = V_{IL}$ and<br>$\overline{CE}^*B = V_{IH}^{(3)}$<br>Active Port Outputs Disabled, $f = f_{MAX}^{(1)}$                                                                   | COM'L   | S | 140                       | 270  | 130                         | 230  | 120                        | 220  | mA   |
|        |                                                          |                                                                                                                                                                                             |         | L | 140                       | 240  | 130                         | 200  | 120                        | 190  |      |
|        |                                                          |                                                                                                                                                                                             | IND     | S | —                         | —    | 130                         | 245  | —                          | —    |      |
|        |                                                          |                                                                                                                                                                                             |         | L | —                         | —    | 130                         | 215  | —                          | —    |      |
| ISB3   | Full Standby Current<br>(Both Ports - CMOS Level Inputs) | Both Ports $\overline{CE}_R$ and<br>$\overline{CE}_L \geq V_{CC} - 0.2V$<br>$V_{IN} \geq V_{CC} - 0.2V$ or<br>$V_{IN} \leq 0.2V$ , $f = 0^{(2)}$                                            | COM'L   | S | 1.0                       | 15   | 1.0                         | 15   | 1.0                        | 15   | mA   |
|        |                                                          |                                                                                                                                                                                             |         | L | 0.2                       | 5    | 0.2                         | 5    | 0.2                        | 5    |      |
|        |                                                          |                                                                                                                                                                                             | IND     | S | —                         | —    | 1.0                         | 15   | —                          | —    |      |
|        |                                                          |                                                                                                                                                                                             |         | L | —                         | —    | 0.2                         | 5    | —                          | —    |      |
| ISB4   | Full Standby Current<br>(One Port - CMOS Level Inputs)   | $\overline{CE}^*A \leq 0.2V$ and<br>$\overline{CE}^*B \geq V_{CC} - 0.2V^{(5)}$<br>$V_{IN} \geq V_{CC} - 0.2V$ or<br>$V_{IN} \leq 0.2V$ , Active Port Outputs Disabled, $f = f_{MAX}^{(1)}$ | COM'L   | S | 130                       | 245  | 120                         | 205  | 110                        | 195  | mA   |
|        |                                                          |                                                                                                                                                                                             |         | L | 130                       | 225  | 120                         | 185  | 110                        | 175  |      |
|        |                                                          |                                                                                                                                                                                             | IND     | S | —                         | —    | 120                         | 220  | —                          | —    |      |
|        |                                                          |                                                                                                                                                                                             |         | L | —                         | —    | 120                         | 200  | —                          | —    |      |

3242 tbl 09

### NOTES:

- At  $f = f_{MAX}$ , address and control lines (except Output Enable) are cycling at the maximum frequency clock cycle of 1/tcyc, 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".
- $V_{CC} = 5V$ ,  $T_A = 25^\circ C$  for Typ, and are not production tested.  $I_{CC DC}(f=0) = 150mA$  (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  $CE_{1X} \geq V_{CC} - 0.2V$   
 $\overline{CE}_X \geq V_{CC} - 0.2V$  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.
- 'X' in part numbers indicate power (S or L).

## 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 |

3242 tbl 10

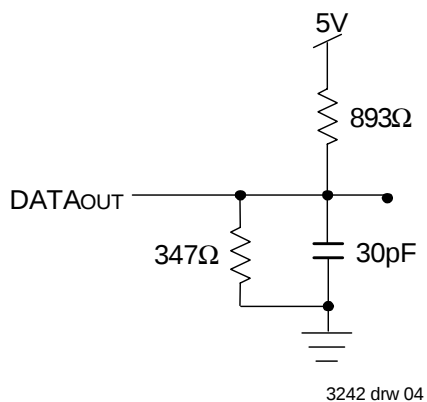


Figure 1. AC Output Test load.

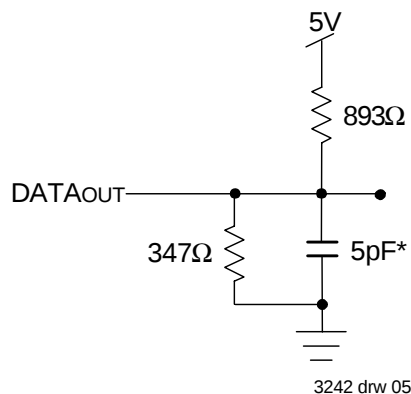


Figure 2. Output Test Load  
(For tCKLZ, tCKHZ, tOLZ, and tOHZ).  
\*Including scope and jig.

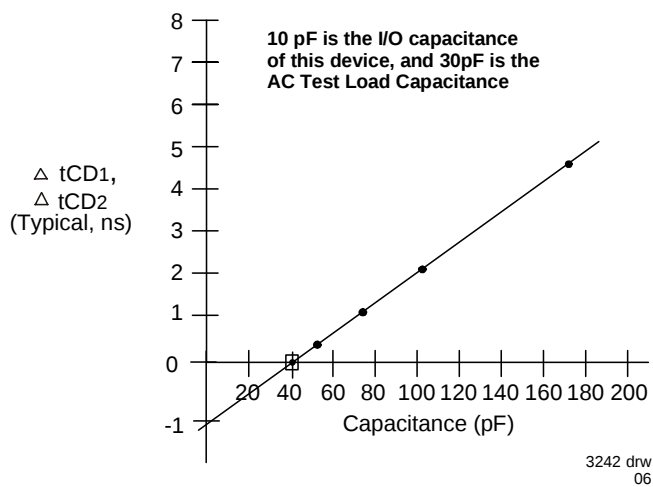


Figure 3. Typical Output Derating (Lumped Capacitive Load).

## AC Electrical Characteristics Over the Operating Temperature Range (Read and Write Cycle Timing)<sup>(3,4)</sup> ( $V_{CC} = 5V \pm 10\%$ )

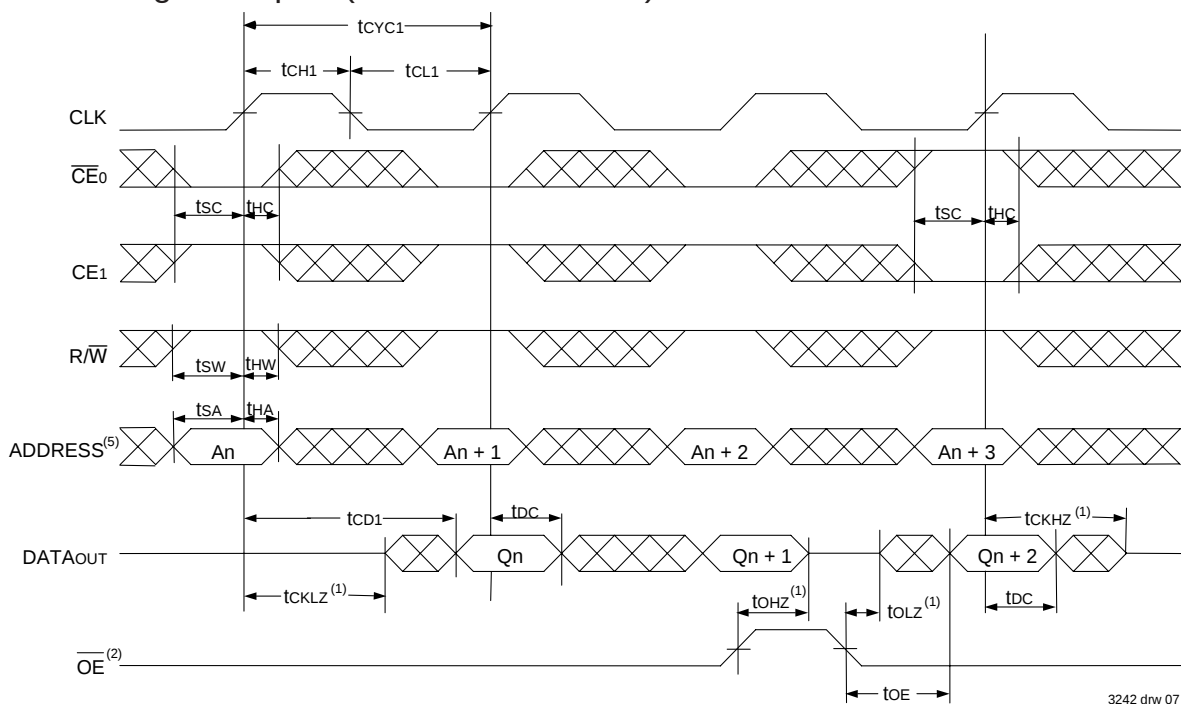
|                           |                                                   | 709089/79X9<br>Com'l Only |      | 709089/79X12<br>Com'l<br>& Ind |      | 709089/79X15<br>Com'l Only |      |      |
|---------------------------|---------------------------------------------------|---------------------------|------|--------------------------------|------|----------------------------|------|------|
| Symbol                    | Parameter                                         | Min.                      | Max. | Min.                           | Max. | Min.                       | Max. | Unit |
| t <sub>CYC1</sub>         | Clock Cycle Time (Flow-Through) <sup>(2)</sup>    | 25                        | —    | 30                             | —    | 35                         | —    | ns   |
| t <sub>CYC2</sub>         | Clock Cycle Time (Pipelined) <sup>(2)</sup>       | 15                        | —    | 20                             | —    | 25                         | —    | ns   |
| t <sub>CH1</sub>          | Clock High Time (Flow-Through) <sup>(2)</sup>     | 12                        | —    | 12                             | —    | 12                         | —    | ns   |
| t <sub>CL1</sub>          | Clock Low Time (Flow-Through) <sup>(2)</sup>      | 12                        | —    | 12                             | —    | 12                         | —    | ns   |
| t <sub>CH2</sub>          | Clock High Time (Pipelined) <sup>(2)</sup>        | 6                         | —    | 8                              | —    | 10                         | —    | ns   |
| t <sub>CL2</sub>          | Clock Low Time (Pipelined) <sup>(2)</sup>         | 6                         | —    | 8                              | —    | 10                         | —    | ns   |
| t <sub>R</sub>            | Clock Rise Time                                   | —                         | 3    | —                              | 3    | —                          | 3    | ns   |
| t <sub>F</sub>            | Clock Fall Time                                   | —                         | 3    | —                              | 3    | —                          | 3    | ns   |
| t <sub>SA</sub>           | Address Setup Time                                | 4                         | —    | 4                              | —    | 4                          | —    | ns   |
| t <sub>HA</sub>           | Address Hold Time                                 | 1                         | —    | 1                              | —    | 1                          | —    | ns   |
| t <sub>SC</sub>           | Chip Enable Setup Time                            | 4                         | —    | 4                              | —    | 4                          | —    | ns   |
| t <sub>HC</sub>           | Chip Enable Hold Time                             | 1                         | —    | 1                              | —    | 1                          | —    | ns   |
| t <sub>SW</sub>           | R/ $\overline{W}$ Setup Time                      | 4                         | —    | 4                              | —    | 4                          | —    | ns   |
| t <sub>HW</sub>           | R/ $\overline{W}$ Hold Time                       | 1                         | —    | 1                              | —    | 1                          | —    | ns   |
| t <sub>SD</sub>           | Input Data Setup Time                             | 4                         | —    | 4                              | —    | 4                          | —    | ns   |
| t <sub>HD</sub>           | Input Data Hold Time                              | 1                         | —    | 1                              | —    | 1                          | —    | ns   |
| t <sub>SAD</sub>          | $\overline{ADS}$ Setup Time                       | 4                         | —    | 4                              | —    | 4                          | —    | ns   |
| t <sub>HAD</sub>          | $\overline{ADS}$ Hold Time                        | 1                         | —    | 1                              | —    | 1                          | —    | ns   |
| t <sub>SCN</sub>          | $\overline{CNTEN}$ Setup Time                     | 4                         | —    | 4                              | —    | 4                          | —    | ns   |
| t <sub>HCN</sub>          | $\overline{CNTEN}$ Hold Time                      | 1                         | —    | 1                              | —    | 1                          | —    | ns   |
| t <sub>SRST</sub>         | $\overline{CNRST}$ Setup Time                     | 4                         | —    | 4                              | —    | 4                          | —    | ns   |
| t <sub>HRST</sub>         | $\overline{CNRST}$ Hold Time                      | 1                         | —    | 1                              | —    | 1                          | —    | ns   |
| t <sub>OE</sub>           | Output Enable to Data Valid                       | —                         | 9    | —                              | 12   | —                          | 15   | ns   |
| t <sub>OLZ</sub>          | Output Enable to Output Low-Z <sup>(1)</sup>      | 2                         | —    | 2                              | —    | 2                          | —    | ns   |
| t <sub>OHZ</sub>          | Output Enable to Output High-Z <sup>(1)</sup>     | 1                         | 7    | 1                              | 7    | 1                          | 7    | ns   |
| t <sub>CD1</sub>          | Clock to Data Valid (Flow-Through) <sup>(2)</sup> | —                         | 20   | —                              | 25   | —                          | 30   | ns   |
| t <sub>CD2</sub>          | Clock to Data Valid (Pipelined) <sup>(2)</sup>    | —                         | 9    | —                              | 12   | —                          | 15   | ns   |
| t <sub>DC</sub>           | Data Output Hold After Clock High                 | 2                         | —    | 2                              | —    | 2                          | —    | ns   |
| t <sub>CKHZ</sub>         | Clock High to Output High-Z <sup>(1)</sup>        | 2                         | 9    | 2                              | 9    | 2                          | 9    | ns   |
| t <sub>CKLZ</sub>         | Clock High to Output Low-Z <sup>(1)</sup>         | 2                         | —    | 2                              | —    | 2                          | —    | ns   |
| <b>Port-to-Port Delay</b> |                                                   |                           |      |                                |      |                            |      |      |
| t <sub>CWDD</sub>         | Write Port Clock High to Read Data Delay          | —                         | 35   | —                              | 40   | —                          | 50   | ns   |
| t <sub>CCS</sub>          | Clock-to-Clock Setup Time                         | —                         | 15   | —                              | 15   | —                          | 20   | ns   |

### NOTES:

3242 tbl 11

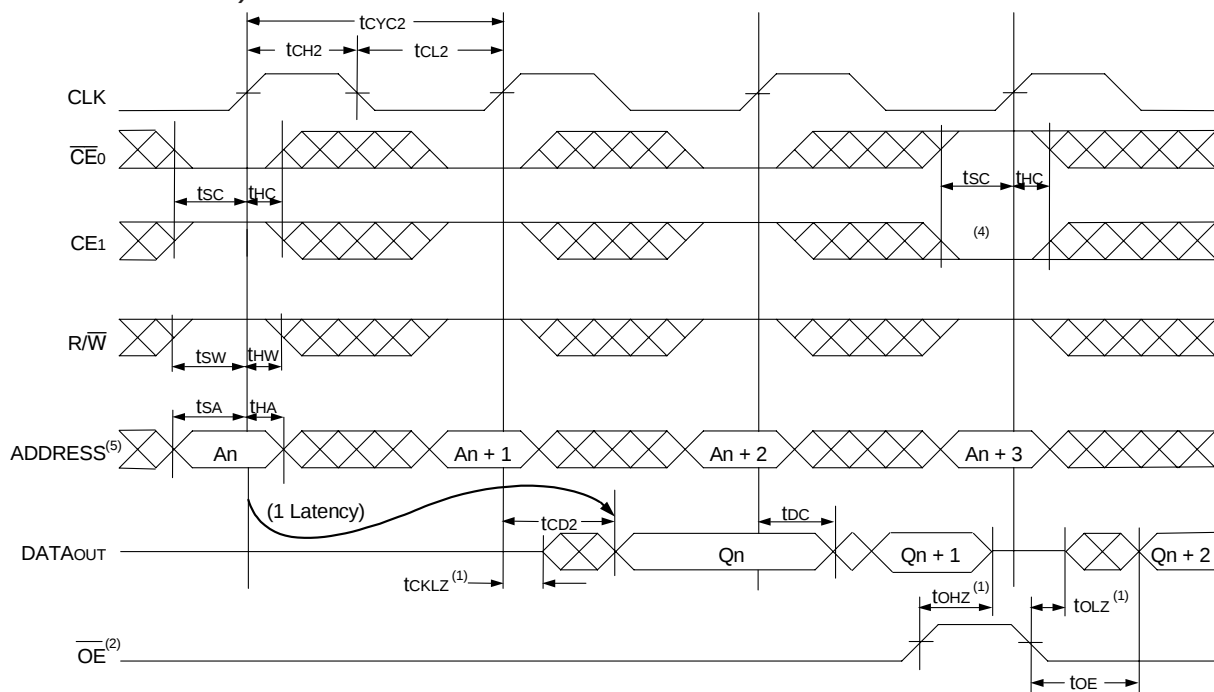
1. Transition is measured 0mV from Low or High-impedance voltage with the Output Test Load (Figure 2). This parameter is guaranteed by device characterization, but is not production tested.
2. The Pipelined output parameters (t<sub>CYC2</sub>, t<sub>CD2</sub>) apply to either or both left and right ports when  $\overline{FT}/PIPE = V_{IH}$ . Flow-through parameters (t<sub>CYC1</sub>, t<sub>CD1</sub>) 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 ( $\overline{OE}$ ) and  $\overline{FT}/PIPE$ .  $\overline{FT}/PIPE$  should be treated as a DC signal, i.e. steady state during operation.
4. 'X' in part number indicates power rating (S or L).

## Timing Waveform of Read Cycle for Flow-Through Output ( $\overline{\text{FT}}/\text{PIPE} \text{ "X" } = V_{\text{IL}}$ )<sup>(3,6)</sup>



3242 drw 07

## Timing Waveform of Read Cycle for Pipelined Output ( $\overline{\text{FT}}/\text{PIPE} \text{ "X" } = V_{\text{IH}}$ )<sup>(3,6)</sup>

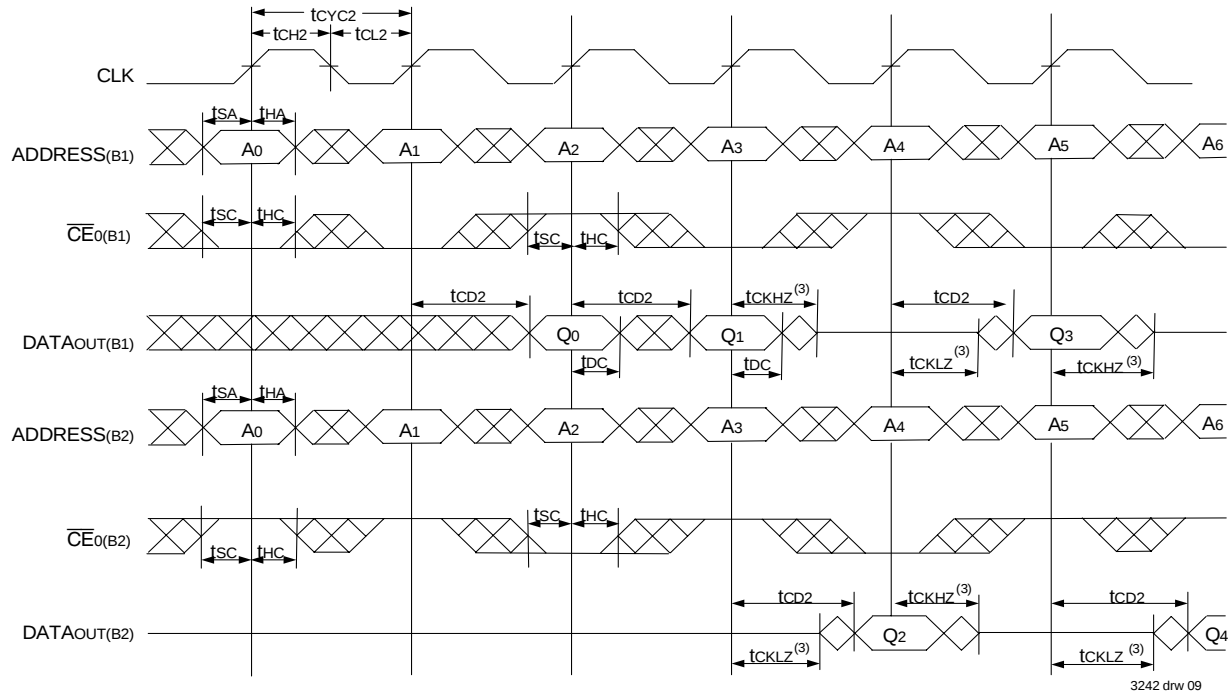


3242 drw 08

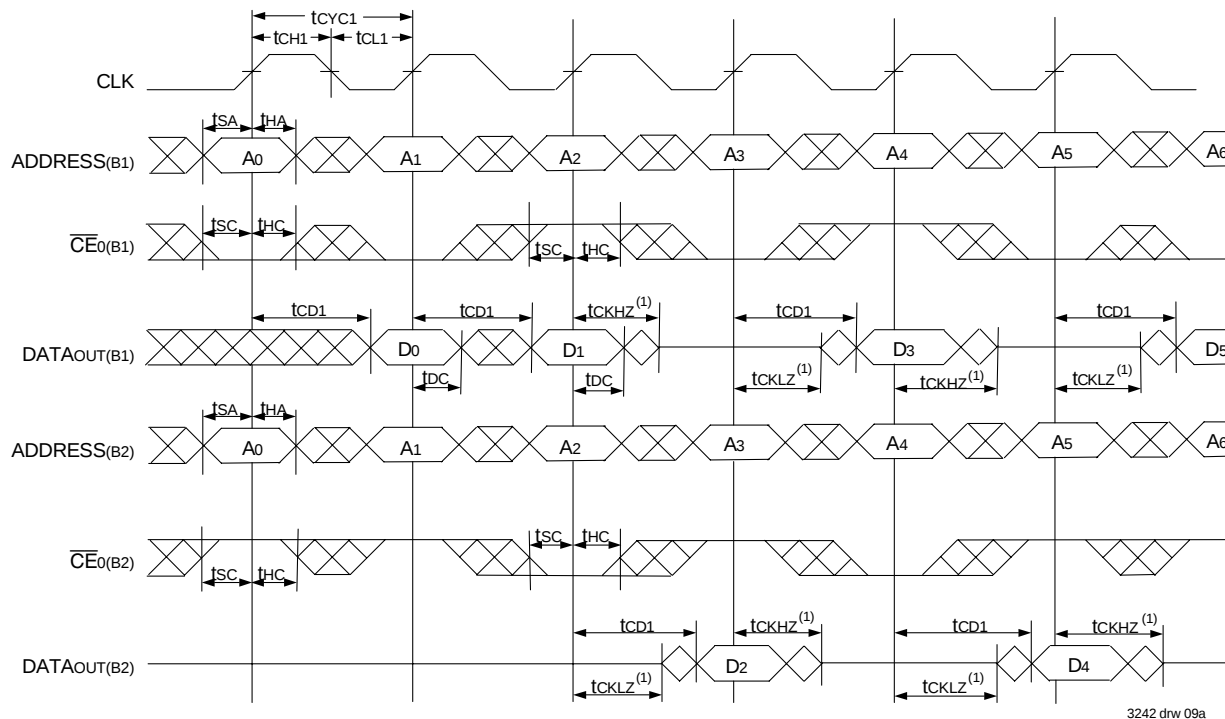
### NOTES:

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.  $\text{ADS} = V_{\text{IL}}$  and  $\text{CNTRST} = V_{\text{IH}}$ .
4. The output is disabled (High-Impedance state) by  $\overline{\text{CE}}_0 = V_{\text{IH}}$  or  $\text{CE}_1 = V_{\text{IL}}$  following the next rising edge of clock. Refer to Truth Table 1.
5. Addresses do not have to be accessed sequentially since  $\text{ADS} = V_{\text{IL}}$  constantly loads the address on the rising edge of the CLK; numbers are for reference use only.
6. "X" denotes Left or Right port. The diagram is with respect to that port.

## Timing Waveform of a Bank Select Pipelined Read<sup>(1,2)</sup>



## Timing Waveform of a Bank Select Flow-Through Read<sup>(6,7)</sup>



### NOTES:

1. B1 Represents Bank #1; B2 Represents Bank #2. Each Bank consists of one IDT709089/79 for this waveform, and are setup for depth expansion in this example. ADDRESS<sub>(B1)</sub> = ADDRESS<sub>(B2)</sub> in this situation.
2.  $\overline{OE}$  and  $\overline{ADS} = V_{IL}$ ; CE<sub>1(B1)</sub>, CE<sub>1(B2)</sub>, R/W and 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<sub>1</sub> 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  $t_{CWD0}$ .  
If  $t_{CCS} >$  maximum specified, then data from right port READ is not valid until  $t_{CCS} + t_{CD1}$ .  $t_{CWD0}$  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 of Port "A".

The diagram illustrates the timing requirements for the 74VHC163 4-bit binary counter. It shows the relationship between the clock signals (CLK "A" and CLK "B"), the address bus (ADDRESS "A" and ADDRESS "B"), and the data bus (DATA IN "A" and DATA OUT "B").

**Top Section (Address A and Data A):**

- CLK "A":** The clock signal for the first counter.
- R $\overline{W}$ "A":** The read/write control signal for the first counter. It is active low (indicated by a bubble).
- ADDRESS "A":** The address bus for the first counter. It shows a "MATCH" condition followed by a "NO MATCH" condition.
- DATA IN "A":** The data input bus for the first counter. It shows a "VALID" condition.
- Timing Parameters:**
  - $t_{SW}$  and  $t_{HW}$ : Setup and hold times for the read/write control signal.
  - $t_{SA}$  and  $t_{HA}$ : Setup and hold times for the address bus.
  - $t_{SD}$  and  $t_{HD}$ : Setup and hold times for the data input bus.

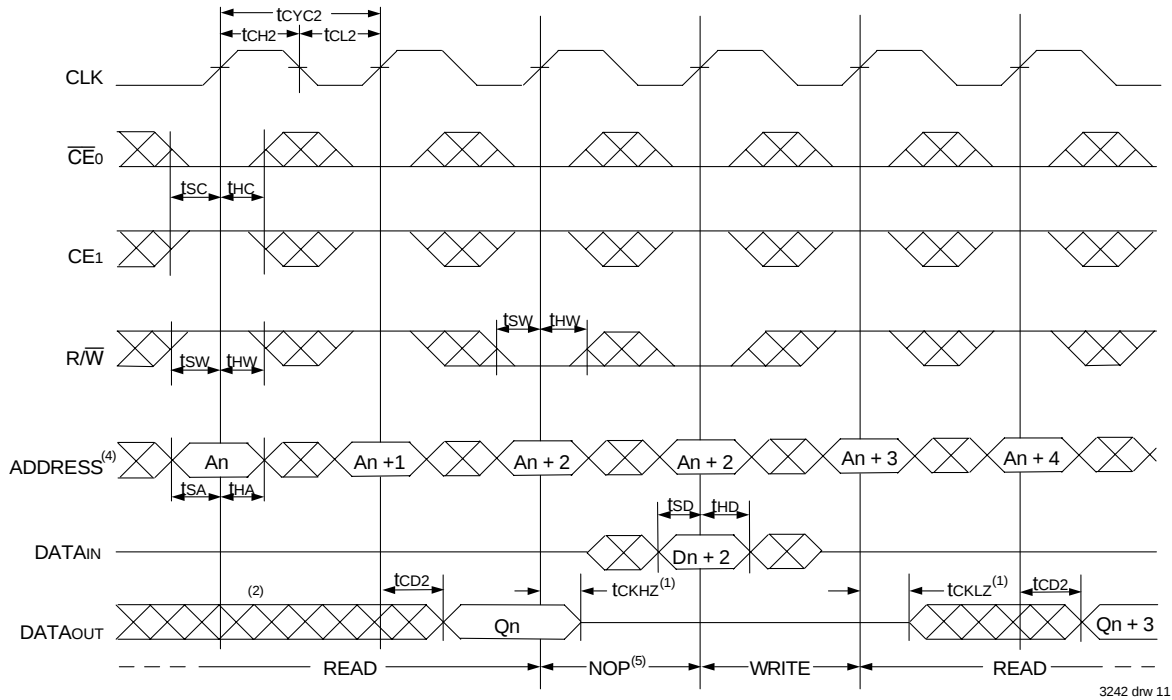
**Bottom Section (Address B and Data B):**

- CLK "B":** The clock signal for the second counter.
- R $\overline{W}$ "B":** The read/write control signal for the second counter. It is active low (indicated by a bubble).
- ADDRESS "B":** The address bus for the second counter. It shows a "MATCH" condition followed by a "NO MATCH" condition.
- DATA OUT "B":** The data output bus for the second counter. It shows a "VALID" condition.
- Timing Parameters:**
  - $t_{CCS}^{(4)}$ : Clock-to-counter setup time.
  - $t_{CD1}$ : Clock-to-output delay.
  - $t_{SW}$  and  $t_{HW}$ : Setup and hold times for the read/write control signal.
  - $t_{SA}$  and  $t_{HA}$ : Setup and hold times for the address bus.
  - $t_{CWDD}^{(4)}$ : Clock-to-output delay.
  - $t_{DC}$ : Data-to-output delay.

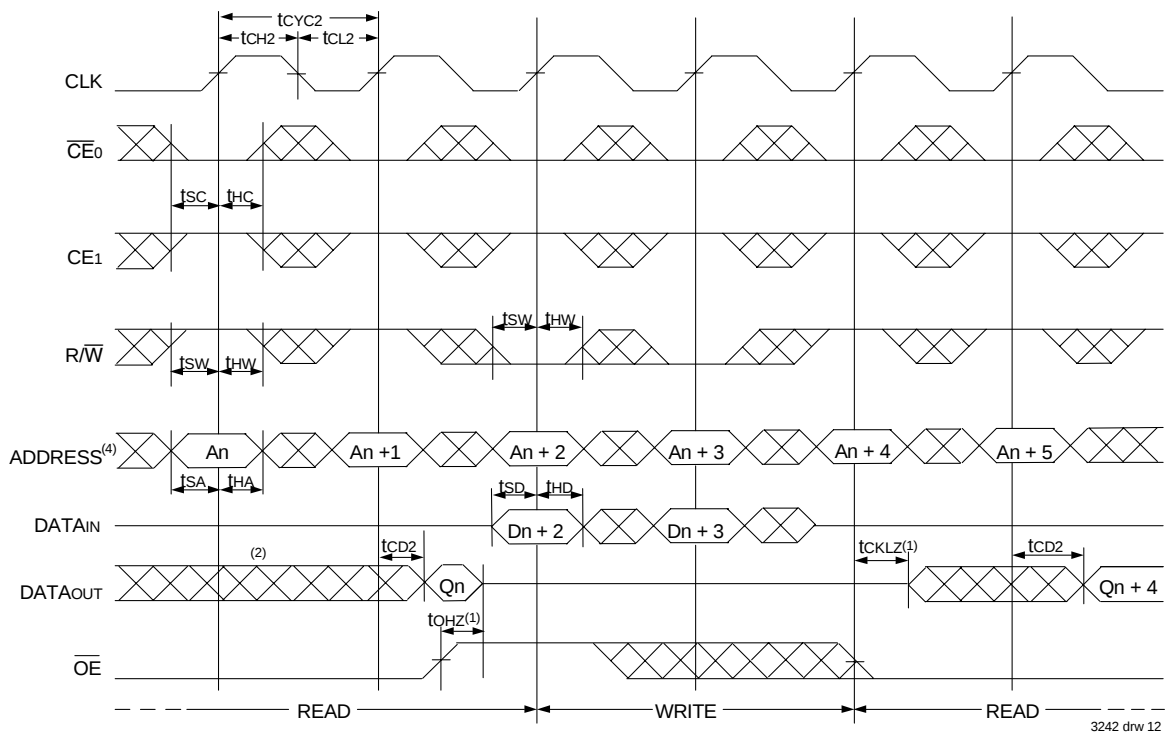
3242 drw 10

1. Transition is measured 0mV from Low or High-impedance voltage with the Output Test Load (Figure 2).
2.  $\overline{CE0}$  and  $\overline{ADS} = V_{IL}$ ;  $CE1$  and  $\overline{CNTRST} = V_{IH}$ .
3.  $\overline{OE} = V_{IL}$  for the Right Port, which is being read from.  $\overline{OE} = V_{IH}$  for the Left Port, which is being written to.
4. If  $t_{ccs} \leq$  maximum specified, then data from right port READ is not valid until the maximum specified for  $tc_{wdb}$ .  
If  $t_{ccs} >$  maximum specified, then data from right port READ is not valid until  $t_{ccs} + tc_{d1}$ .  $tc_{wdb}$  does not apply in this case.
5. 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 of Port "A".

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



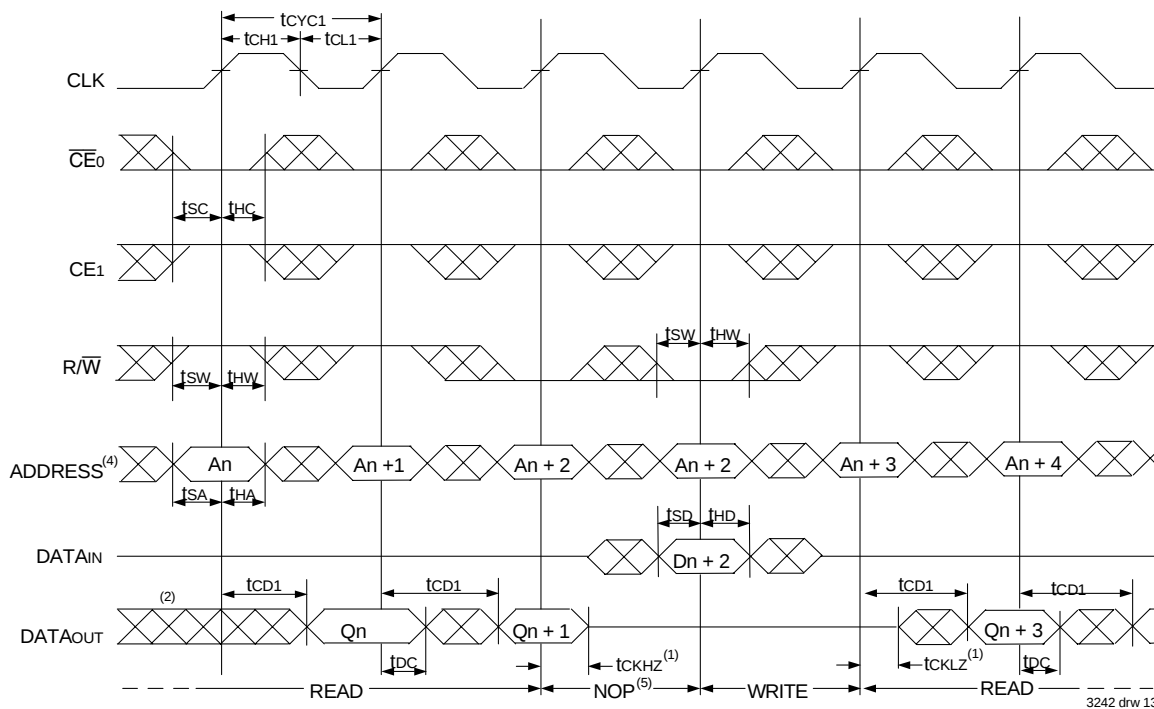
## Timing Waveform of Pipelined Read-to-Write-to-Read ( $\overline{OE}$ Controlled)<sup>(3)</sup>



### NOTES:

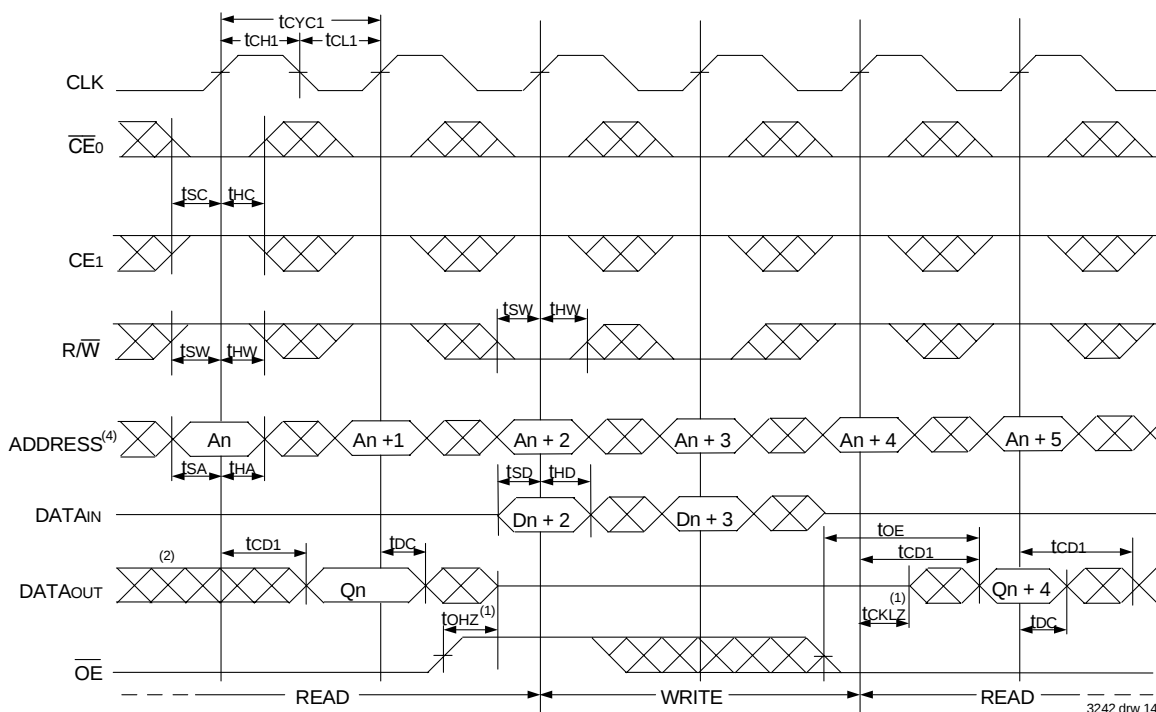
1. Transition is measured 0mV from Low or High-impedance voltage with the Output Test Load (Figure 2).
2. Output state (High, Low, or High-impedance) is determined by the previous cycle control signals.
3.  $\overline{CE0}$  and  $\overline{ADS} = V_{IL}$ ;  $CE1$  and  $\overline{CNTRST} = V_{IH}$ .
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. "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 Flow-Through Read-to-Write-to-Read ( $\overline{OE} = V_{IL}$ )<sup>(3)</sup>



3242 drw 13

## Timing Waveform of Flow-Through Read-to-Write-to-Read ( $\overline{OE}$ Controlled)<sup>(3)</sup>

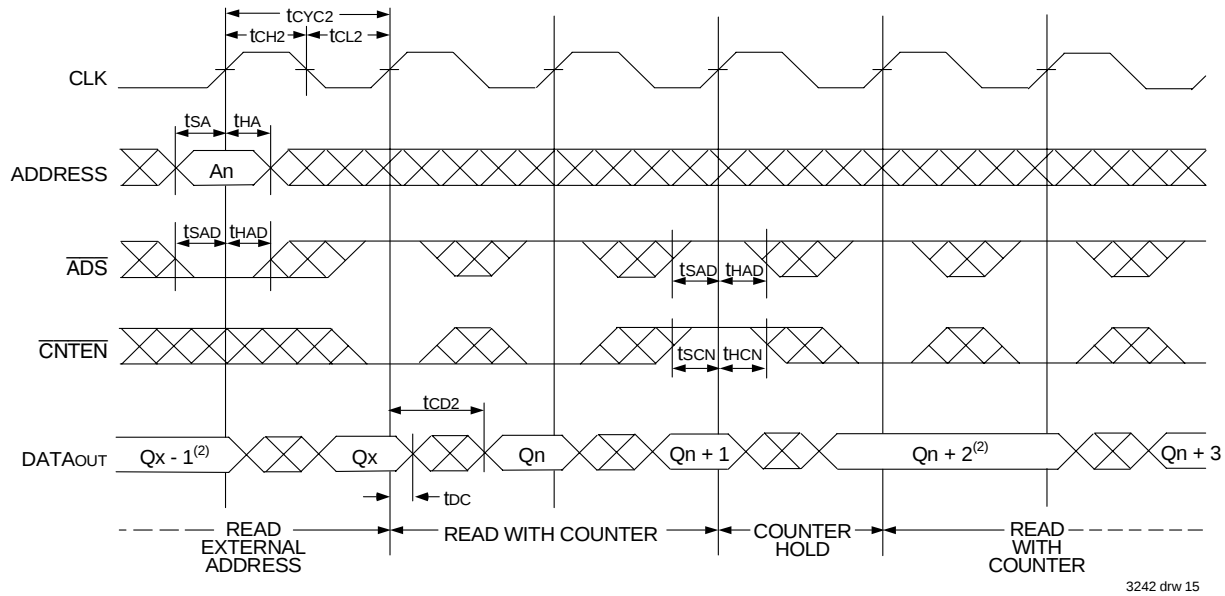


3242 drw 14

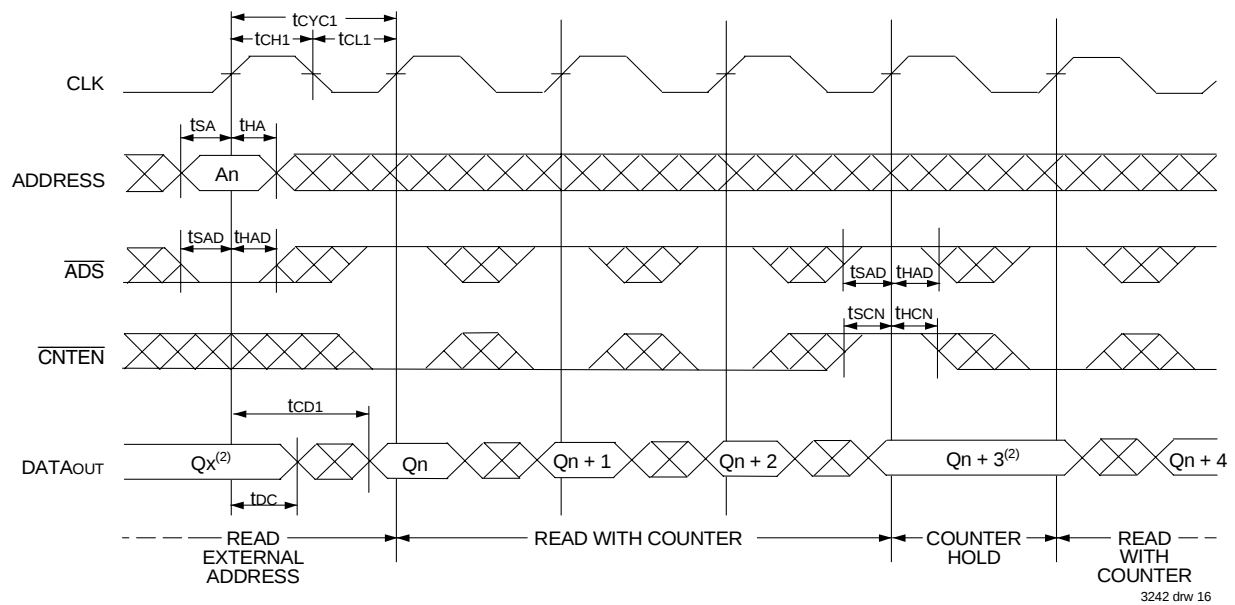
### NOTES:

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.  $\overline{CE0}$  and  $\overline{ADS} = V_{IL}$ ;  $CE1$  and  $\overline{CNTRST} = V_{IH}$ .
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. "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<sup>(1)</sup>



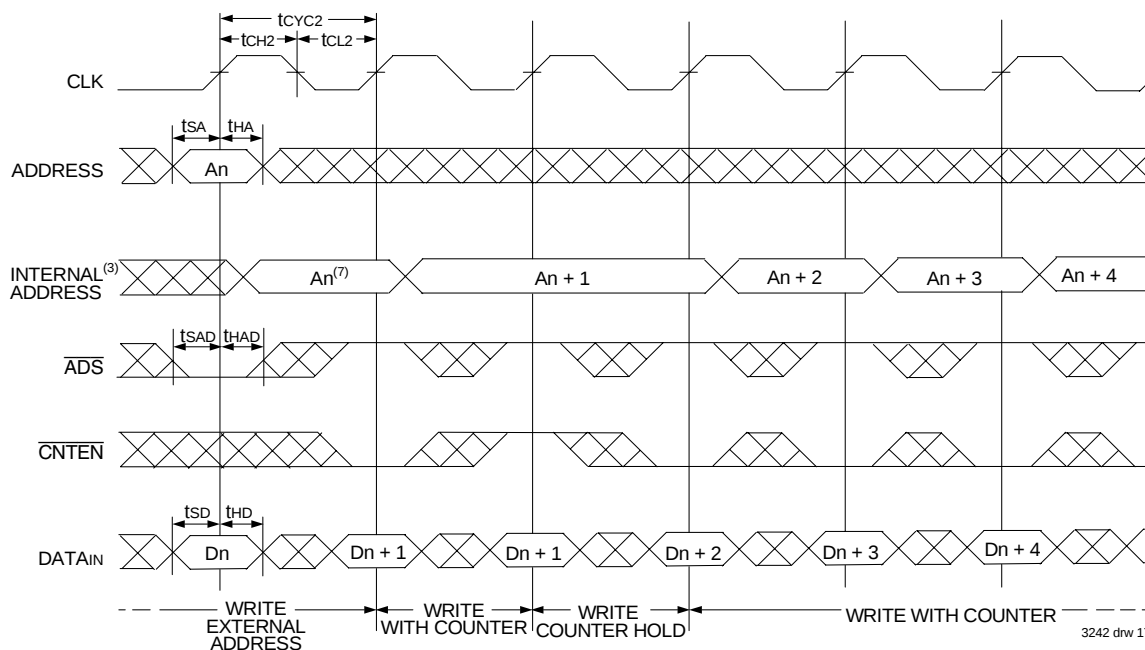
## Timing Waveform of Flow-Through Read with Address Counter Advance<sup>(1)</sup>



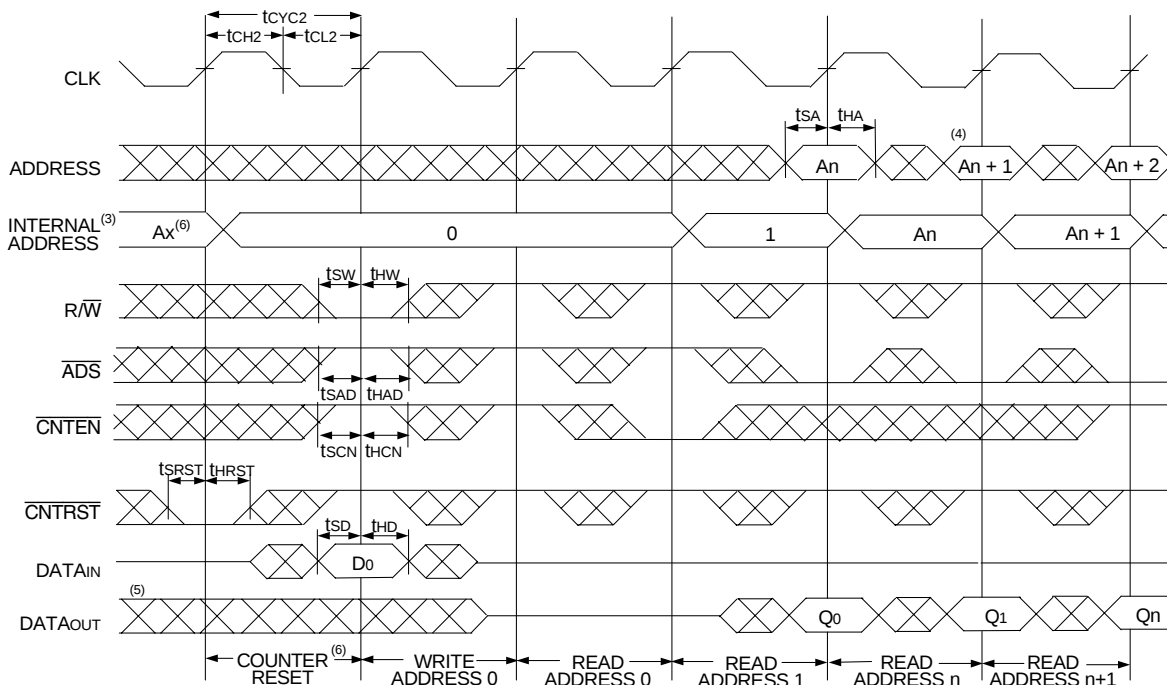
### NOTES:

1.  $\overline{CE_0}$  and  $\overline{OE} = V_{IL}$ ;  $CE_1$ ,  $R/\overline{W}$ , and  $\overline{CNTST} = V_{IH}$ .
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)<sup>(1)</sup>



## Timing Waveform of Counter Reset (Pipelined Outputs)<sup>(2)</sup>



### 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.  $ADDR_0$  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 IDT709089/79 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.

A HIGH on  $\overline{CE_0}$  or a LOW on  $CE_1$  for one clock cycle will power down the internal circuitry to reduce static power consumption. Multiple chip enables allow easier banking of multiple IDT709089/79's for depth expansion configurations. When the Pipelined output mode is enabled, two cycles are required with  $\overline{CE_0}$  LOW and  $CE_1$  HIGH to re-activate the outputs.

## Depth and Width Expansion

The IDT709089/79 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 IDT709089/79 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 16-bit or wider applications.

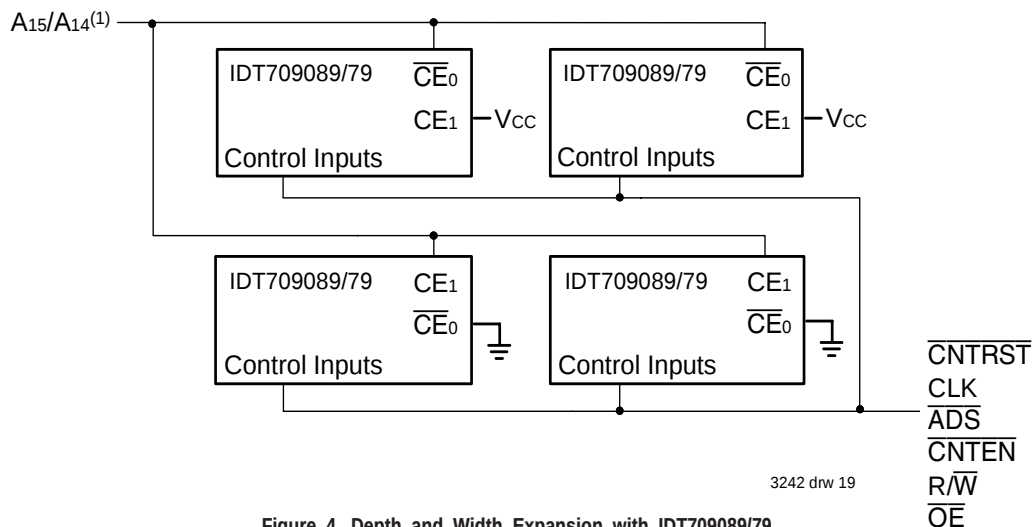
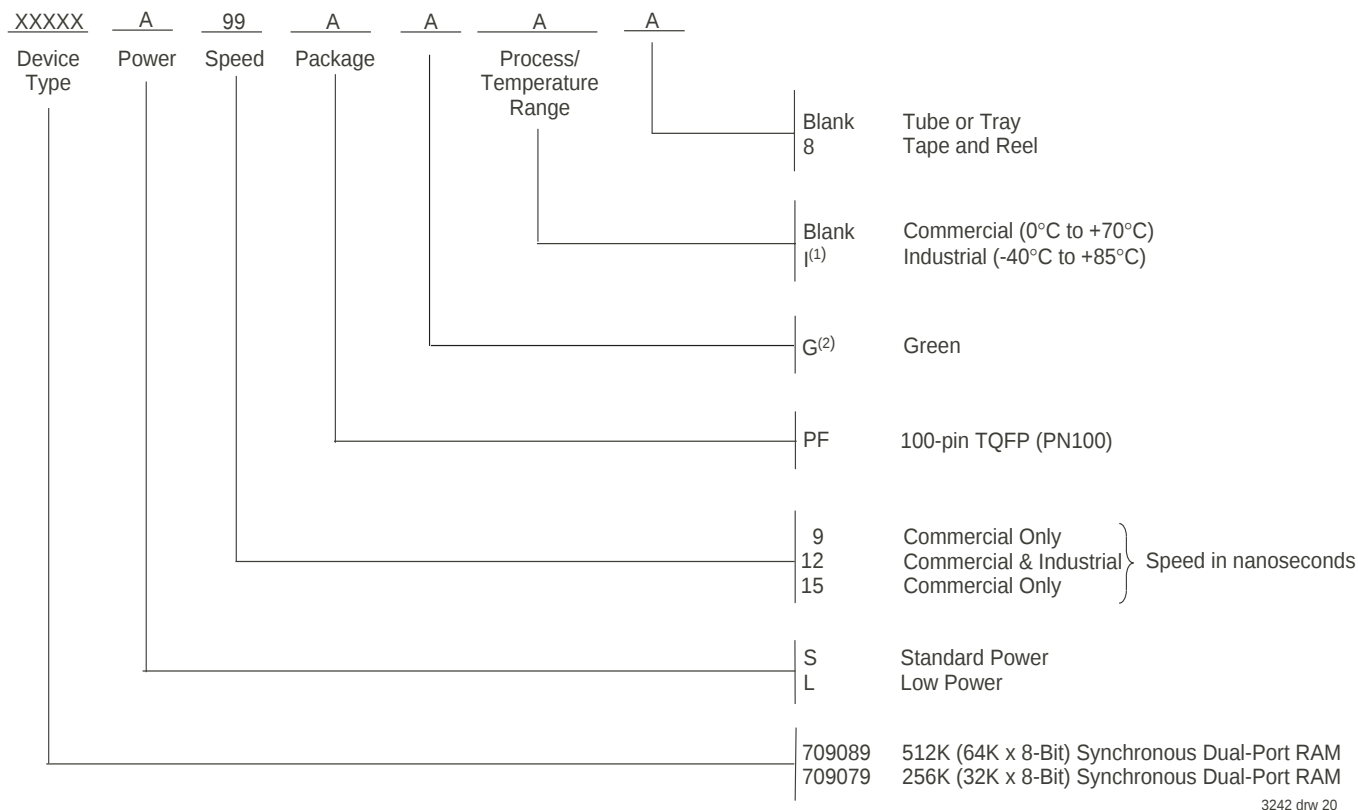


Figure 4. Depth and Width Expansion with IDT709089/79

### NOTE:

1.  $A_{15}$  is for IDT709089,  $A_{14}$  is for IDT709079.

## Ordering Information



### NOTE:

1. Contact your local sales office for industrial temp range for other speeds, packages and powers.
2. Green parts available. For specific speeds, packages and powers contact your sales office.

## Ordering Information for Flow-through Devices

| Old Flow-through Part | New Combined Part |
|-----------------------|-------------------|
| 70908S/L20            | 709089S/L9        |
| 70908S/L25            | 709089S/L12       |
| 70908S/L30            | 709089S/L15       |

3242 tbl 12

## Datasheet Document History

|           |         |                                                                                                                                                           |
|-----------|---------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1/12/99:  |         | Initiated datasheet document history<br>Converted to new format<br>Cosmetic and typographical corrections<br>Added additional notes to pin configurations |
| 6/7/99:   | Page 15 | Added Depth and Width Expansion note<br>Changed drawing format                                                                                            |
| 11/10/99: | Page 4  | Deleted note 6 for Table II<br>Replaced IDT logo                                                                                                          |

## Datasheet Document History (con't)

|           |             |                                                                                                                                                                                                                                   |
|-----------|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 12/22/99: | Page 1      | Removed "Separate upper-byte..." line                                                                                                                                                                                             |
| 1/12/00:  |             | Combined Pipelined 709089 family and Flow-through 70908 family offerings into one data sheet                                                                                                                                      |
|           |             | Changed $\pm 200\text{mV}$ in waveform notes to $0\text{mV}$                                                                                                                                                                      |
|           |             | Added corresponding part chart with ordering information                                                                                                                                                                          |
| 2/18/00:  | Pages 8 & 9 | Changed $\pm 220\text{mV}$ waveform notes to $0\text{mV}$                                                                                                                                                                         |
|           | Page 9      | Changed "Operation" in heading to "Pipelined Output", fixed drawing 08                                                                                                                                                            |
|           |             | Removed PGA package                                                                                                                                                                                                               |
| 5/24/00:  | Page 3      | Changed information in Truth Table II                                                                                                                                                                                             |
|           | Page 4      | Increased storage temperature parameters                                                                                                                                                                                          |
|           |             | Clarified $T_A$ parameter                                                                                                                                                                                                         |
|           | Page 5      | DC Electrical parameters—changed wording from "open" to "disabled"                                                                                                                                                                |
|           |             | Added Industrial Temperature Ranges and removed related notes                                                                                                                                                                     |
| 01/10/02: | Page 2      | Added date revision for pin configuration                                                                                                                                                                                         |
|           | Page 5 & 7  | Removed industrial temp from column headings and values for 15ns from AC & DC Electrical Characteristics                                                                                                                          |
|           | Page 16     | Removed industrial offering from 15ns ordering info and added industrial temp footnote                                                                                                                                            |
|           | Page 1 & 17 | Replaced IDT <sup>TM</sup> logo with ® logo                                                                                                                                                                                       |
| 06/21/04: |             | Consolidated multiple devices into one datasheet                                                                                                                                                                                  |
|           |             | Removed Preliminary status from datasheet                                                                                                                                                                                         |
|           | Page 4      | Added Junction Temperature to Absolute Maximum Ratings Table                                                                                                                                                                      |
|           |             | Added Ambient Temperature footnote                                                                                                                                                                                                |
|           | Page 5      | Added 6ns & 7ns speed DC timing numbers to the DC Electrical Characteristics Table                                                                                                                                                |
|           | Page 8      | Added 6ns & 7ns speed AC timing numbers to the AC Electrical Characteristics Table                                                                                                                                                |
|           | Page 17     | Added 6ns & 7ns speed grades to ordering information                                                                                                                                                                              |
|           |             | Added IDT Clock Solution Table                                                                                                                                                                                                    |
|           | Page 1 & 18 | Replaced old ® logo with new <sup>TM</sup> logo                                                                                                                                                                                   |
| 01/29/09: | Page 17     | Removed "IDT" from orderable part number                                                                                                                                                                                          |
| 07/26/10: | Page 1      | Added green parts availability to features                                                                                                                                                                                        |
|           | Page 17     | Added green indicator to ordering information                                                                                                                                                                                     |
|           | Page 8      | In order to correct the header notes of the AC Elec Chars Table and align them with the Industrial temp range values located in the table, the commercial $T_A$ header note has been removed                                      |
|           | Pages 9-13  | In order to correct the footnotes of timing diagrams, $\overline{\text{CNTEN}}$ has been removed to reconcile the footnotes with the $\overline{\text{CNTEN}}$ logic definition found in Truth Table II - Address Counter Control |
| 05/28/15: | Page 1      | Updated speed offerings and cycle time in Features                                                                                                                                                                                |
|           | Page 2      | Removed IDT in reference to fabrication                                                                                                                                                                                           |
|           | Page 2      | Removed date for the 100-PIN TQFP configuration                                                                                                                                                                                   |
|           | Page 2 & 16 | The package code PN100-1 changed to PN100 to match standard package codes                                                                                                                                                         |
|           | Page 5      | Removed X6 and X7 speed grades from the DC Elec Chars table and combined X9, X12 & X15 speed grades into one DC Elec Chars table                                                                                                  |
|           | Page 6      | Corrected typo in the Typical Output Derating drawing                                                                                                                                                                             |
|           | Page 7      | Removed X6 and X7 speed grades from the AC Elec Chars table                                                                                                                                                                       |
|           | Page 16     | Added Tape and Reel indicator to, removed X6 & X7 speed grades and updated the commercial and industrial offerings in Ordering Information                                                                                        |
|           | Page 16     | Removed the IDT Clock Solution table                                                                                                                                                                                              |
| 02/22/16: | Page 2      | Changed diagram for the PN100 pin configuration by rotating the pin1 orientation counter clockwise by 90 degrees for accurate representation of the part and added the black dot as the pin 1 indicator                           |
|           |             | Added the IDT logo to the pin configuration and changed the text to be in alignment with new diagram marking specs and rotated the pin names on the vertical sides to an upright position                                         |
|           |             | Updated footnote references for the PN100 pin configuration                                                                                                                                                                       |



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