



Integrated Device Technology, Inc.

# 128K x 8 3.3V SYNCHRONOUS SRAM WITH ZBT™ AND FLOW-THROUGH OUTPUT

## ADVANCE INFORMATION IDT71V509

### FEATURES:

- 128K x 8 memory configuration
- High speed - 66 MHz (9 ns Clock-to-Data Access)
- Flow-Through Output
- No dead cycles between Write and Read Cycles
- Low power deselect mode
- Single 3.3V power supply ( $\pm 5\%$ )
- Packaged in 44-lead SOJ

### DESCRIPTION:

The IDT71V509 is a 3.3V high-speed 1,024,576-bit synchronous SRAM organized as 128K x 8. It is designed to eliminate dead cycles when turning the bus around between reads and writes, or writes and reads. Thus, it has been given the name ZBT™, or Zero Bus Turnaround™.

Addresses and control signals are applied to the SRAM

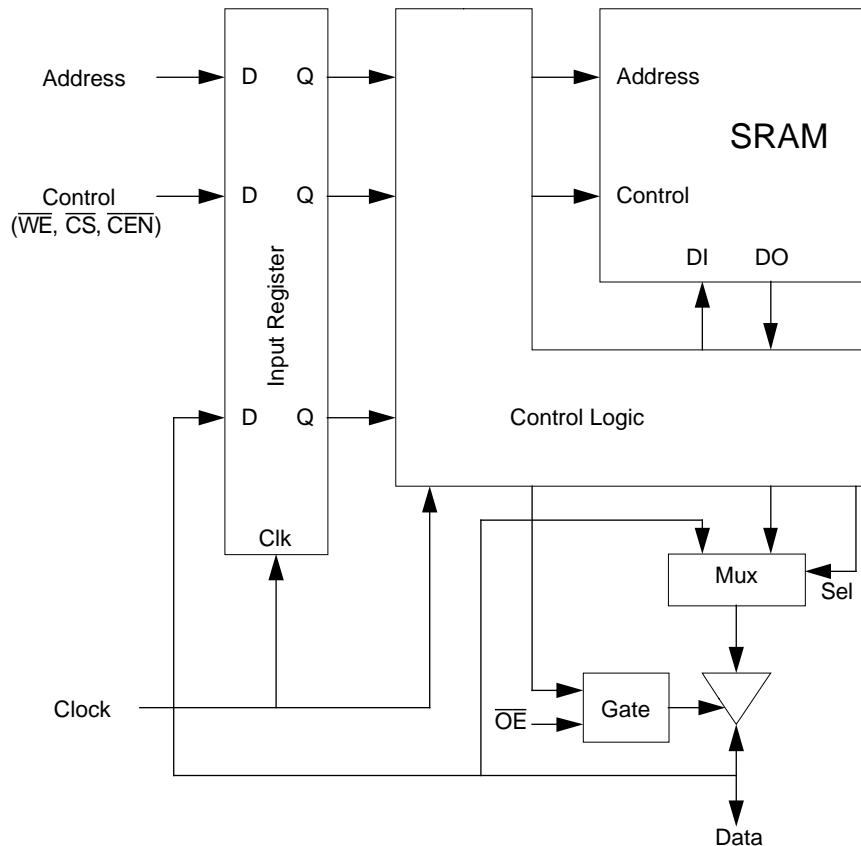
during one clock cycle, and one clock cycle later its associated data cycle occurs, be it read or write.

The IDT71V509 contains data, address, and control signal registers. Output Enable is the only asynchronous signal, and can be used to disable the output at any time.

A Clock Enable ( $\overline{CEN}$ ) pin allows operation of the IDT71V509 to be suspended as long as necessary. All synchronous inputs are ignored when  $\overline{CEN}$  is high. A Chip Select ( $\overline{CS}$ ) pin allows the user to deselect the device when desired. If  $\overline{CS}$  is high, no new memory operation is initiated, but any pending data transfers (reads and writes) will still be completed.

The IDT71V509 utilizes IDT's high-performance 3.3V CMOS process, and is packaged in a JEDEC Standard 400-mil 44-lead small outline J-lead plastic package (SOJ) for high board density.

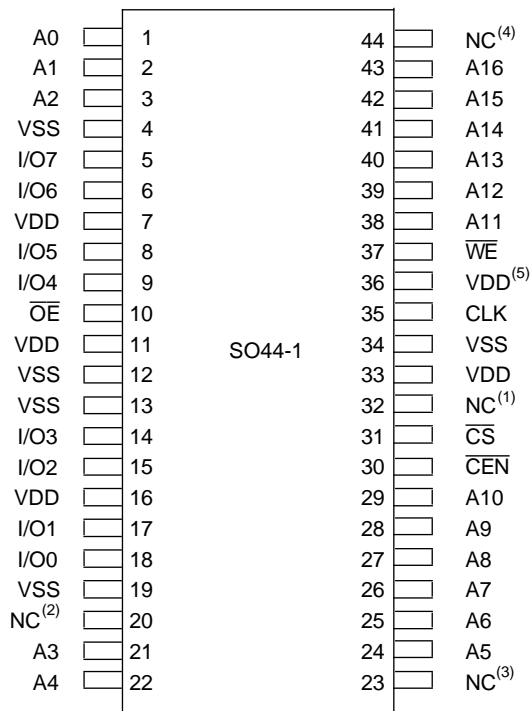
### FUNCTIONAL BLOCK DIAGRAM



3618 drw 01

The IDT logo is a registered trademark and CacheRAM, Zero Bus Turnaround and ZBTare trademarks of Integrated Device Technology, Inc.  
Pentium is a trademark of Intel Corp.  
PowerPC is a trademark of International Business Machines, Inc.

## PIN CONFIGURATION



Notes:

1. Pin 32: Future control input
2. Pin 20: Future I/O8
3. Pin 23: Future A17
4. Pin 44: Future A18
5. Pin 36 does not need to be connected directly to VDD, as long as it is  $\geq V_{IH}$ .

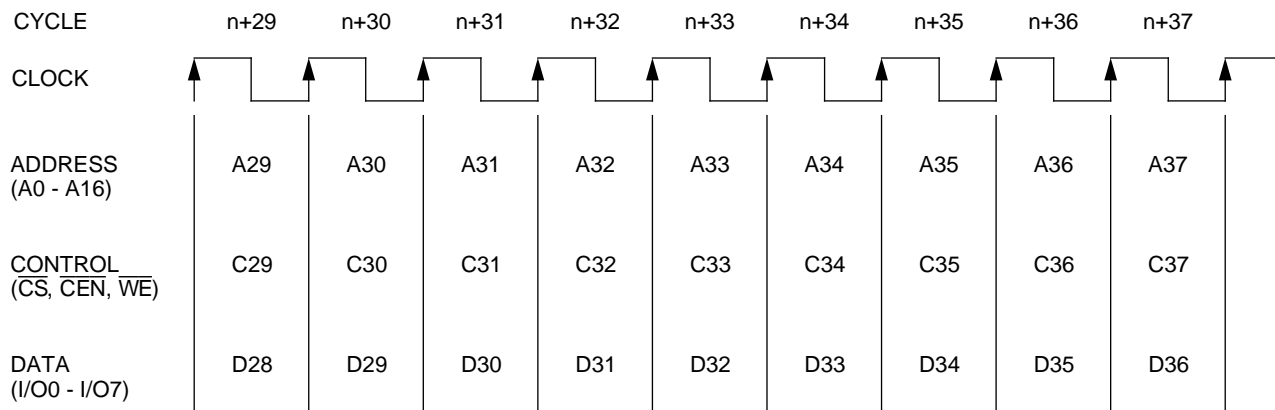
## TOP VIEW

3618 drw 02

## PIN DEFINITIONS<sup>(1)</sup>

Symbol	Pin Function	I/O	Active	Description
A0-A16	Address Inputs	I	N/A	Synchronous Address inputs. The address is registered on every rising edge of CLK if $\overline{CEN}$ and $\overline{CS}$ are both low.
CLK	Clock	I	N/A	The clock input. Except for $\overline{OE}$ , all input and output timing references for the device are with respect to the rising edge of CLK.
$\overline{CEN}$	Clock Enable	I	LOW	Synchronous clock enable input. When $\overline{CEN}$ is sampled high, the other synchronous inputs are ignored, and outputs remain unchanged. When $\overline{CEN}$ is sampled low, the IDT71V509 operates normally.
$\overline{CS}$	Chip Select	I	LOW	Synchronous chip select input. When $\overline{CS}$ is sampled low, the device operates normally. When $\overline{CS}$ is sampled high, no read or write operation is initiated, and the I/O bus is tri-stated the next cycle. $\overline{CS}$ is ignored if $\overline{CEN}$ is high at the same rising edge of CLK.
$\overline{WE}$	Write Enable	I	LOW	Synchronous write enable. If $\overline{WE}$ is sampled low, a write is initiated at the address that is registered at that time. If $\overline{WE}$ is sampled high, a read is initiated at the address that is registered at that time. $\overline{WE}$ is ignored when either $\overline{CEN}$ or $\overline{CS}$ is sampled high.
$\overline{OE}$	Output Enable	I	LOW	Asynchronous output enable. When $\overline{OE}$ is high, the I/O bus goes high impedance. $\overline{OE}$ must be low to read data from the IDT71V509.
I/O0-I/O7	Data Input/Output	I/O	N/A	Synchronous data input/output (I/O) pins. Both the data input path and data output path are registered and triggered by the rising edge of CLK.
VDD	Power Supply	N/A	N/A	3.3V power supply pins.
VSS	Ground	N/A	N/A	Ground pins.

## FUNCTIONAL TIMING DIAGRAM



3618 drw 03

## TYPICAL OPERATION - $\overline{CS}$ AND $\overline{CEN}$ ARE LOW

Cycle	Address	$\overline{WE}$	$\overline{CS}$	$\overline{CEN}$	$\overline{OE}$	I/O	Comments
n	A0	H	L	L	?	D-1	?
n+1	A1	L	L	L	L	D0	Data Out
n+2	A2	H	L	L	X	D1	Data In
n+3	A3	L	L	L	L	D2	Data Out
n+4	A4	H	L	L	X	D3	Data In
n+5	A5	L	L	L	L	D4	Data Out
n+6	A6	H	L	L	X	D5	Data In
n+7	A7	L	L	L	L	D6	Data Out
n+8	A8	H	L	L	X	D7	Data In
n+9	A9	L	L	L	L	D8	Data Out
n+10	A10	H	L	L	X	D9	Data In
n+11	A11	H	L	L	L	D10	Data Out
n+12	A12	L	L	L	L	D11	Data Out
n+13	A13	L	L	L	X	D12	Data In
n+14	A14	H	L	L	X	D13	Data In
n+15	A15	H	L	L	L	D14	Data Out
n+16	A16	H	L	L	L	D15	Data Out
n+17	A17	L	L	L	L	D16	Data Out
n+18	A18	L	L	L	X	D17	Data In
n+19	A19	L	L	L	X	D18	Data In
n+20	A20	H	L	L	X	D19	Data In
n+21	A21	H	L	L	L	D20	Data Out

## READ OPERATION

Cycle	Address	$\overline{WE}$	$\overline{CS}$	$\overline{CEN}$	$\overline{OE}$	I/O	Comments
n	A0	H	L	L	X	X	Address and Control meet setup
n+1	X	X	X	X	L	D0	Contents of Address A0 Read Out

H = High; L = Low; X = Don't Care; ? = Don't Know; Z = High Impedance

3618 tbl 02

## WRITE OPERATION

Cycle	Address	$\overline{WE}$	$\overline{CS}$	$\overline{CEN}$	$\overline{OE}$	I/O	Comments
n	A0	L	L	L	X	X	Address and Control meet setup
n+1	X	X	X	L	X	D0	New Data Drives SRAM Inputs

H = High; L = Low; X = Don't Care; ? = Don't Know; Z = High Impedance

3618 tbl 03

## READ OPERATION WITH CLOCK ENABLE USED

Cycle	Address	$\overline{WE}$	$\overline{CS}$	$\overline{CEN}$	$\overline{OE}$	I/O	Comments
n	A0	H	L	L	X	X	Address and Control meet setup
n+1	X	X	X	H	L	D0	Contents of Address A0 Read Out
n+2	A2	H	L	L	L	D0	Contents of Address A0 Read Out
n+3	X	X	X	H	L	D2	Contents of Address A2 Read Out
n+4	X	X	X	H	L	D2	Contents of Address A2 Read Out
n+5	A5	H	L	L	L	D2	Contents of Address A2 Read Out
n+6	A6	H	L	L	L	D5	Contents of Address A5 Read Out
n+7	A7	?	L	L	L	D6	Contents of Address A6 Read Out

H = High; L = Low; X = Don't Care; ? = Don't Know; Z = High Impedance

3618 tbl 04

## WRITE OPERATION WITH CLOCK ENABLE USED

Cycle	Address	$\overline{WE}$	$\overline{CS}$	$\overline{CEN}$	$\overline{OE}$	I/O	Comments
n	A0	L	L	L	X	X	Address and Control meet setup
n+1	X	X	X	H	X	X	Clock Ignored at n+1 to n+2 Low-to-High
n+2	A2	L	L	L	X	D0	New Data Drives SRAM Inputs
n+3	X	X	X	H	X	X	Clock Ignored at n+3 to n+4 Low-to-High
n+4	X	X	X	H	X	X	Clock Ignored at n+4 to n+5 Low-to-High
n+5	A5	L	L	L	X	D2	New Data Drives SRAM Inputs
n+6	A6	L	L	L	X	D5	New Data Drives SRAM Inputs
n+7	A7	?	L	L	X	D6	New Data Drives SRAM Inputs

H = High; L = Low; X = Don't Care; ? = Don't Know; Z = High Impedance

3618 tbl 05

**READ OPERATION WITH CHIP SELECT USED**

Cycle	Address	$\overline{WE}$	$\overline{CS}$	$\overline{CEN}$	$\overline{OE}$	I/O	Comments
n	X	X	H	L	X	?	Deselected
n+1	X	X	H	L	X	Z	Deselected
n+2	A2	H	L	L	X	Z	Address and Control meet setup
n+3	X	X	H	L	L	D2	Deselected, Contents of Address A2 Read Out
n+4	A4	H	L	L	X	Z	Address and Control meet setup
n+5	X	X	H	L	L	D4	Deselected, Contents of Address A4 Read Out
n+6	X	X	H	L	X	Z	Deselected
n+7	A7	H	L	L	X	Z	Address and Control meet setup
n+8	X	X	H	L	L	D7	Deselected, Contents of Address A7 Read Out
n+9	X	X	H	L	X	Z	Deselected

H = High; L = Low; X = Don't Care; ? = Don't Know; Z = High Impedance

3618 tbl 06

**WRITE OPERATION WITH CHIP SELECT USED**

Cycle	Address	$\overline{WE}$	$\overline{CS}$	$\overline{CEN}$	$\overline{OE}$	I/O	Comments
n	X	X	H	L	X	?	Deselected
n+1	X	X	H	L	X	Z	Deselected
n+2	A2	L	L	L	X	Z	Address and Control meet setup
n+3	X	X	H	L	X	D2	Deselected, New Data Drives SRAM Inputs
n+4	A4	L	L	L	X	Z	Address and Control meet setup
n+5	X	X	H	L	X	D4	Deselected, New Data Drives SRAM Inputs
n+6	X	X	H	L	X	Z	Deselected
n+7	A7	L	L	L	X	Z	Address and Control meet setup
n+8	X	X	X	L	X	D7	Deselected, New Data Drives SRAM Inputs
n+9	X	X	X	L	X	Z	Deselected

H = High; L = Low; X = Don't Care; ? = Don't Know; Z = High Impedance

3618 tbl 07

## ABSOLUTE MAXIMUM RATINGS<sup>(1)</sup>

Symbol	Rating	Com'l.	Unit
V <sub>TERM</sub> <sup>(2)</sup>	Terminal Voltage with Respect to GND	-0.5 to +4.6	V
V <sub>TERM</sub> <sup>(3)</sup>	Terminal Voltage with Respect to GND	-0.5 to V <sub>DD</sub> +0.5	V
T <sub>A</sub>	Operating Temperature	0 to +70	°C
T <sub>BIAS</sub>	Temperature Under Bias	-55 to +125	°C
T <sub>STG</sub>	Storage Temperature	-55 to +125	°C
P <sub>T</sub>	Power Dissipation	1.0	W
I <sub>OUT</sub>	DC Output Current	50	mA

### 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<sub>DD</sub> and Input terminals only.
- I/O terminals.

## RECOMMENDED DC OPERATING CONDITIONS

Symbol	Parameter	Min.	Typ.	Max.	Unit
V <sub>DD</sub>	Supply Voltage	3.135	3.3	3.465	V
V <sub>SS</sub>	Supply Voltage	0	0	0	V
V <sub>IH</sub>	Input High Voltage - Inputs	2.0	—	4.6	V
V <sub>IH</sub>	Input High Voltage - I/O	2.0	—	V <sub>DD</sub> +0.3	V
V <sub>IL</sub>	Input Low Voltage	-0.3 <sup>(1)</sup>	—	0.8	V

### NOTE:

- V<sub>IL</sub> (min.) = -1.5V for pulse width less than 5 ns, once per cycle.

## CAPACITANCE

(T<sub>A</sub> = +25°C, f = 1.0MHz, SOJ package)

Symbol	Parameter <sup>(1)</sup>	Conditions	Max.	Unit
C <sub>IN</sub>	Input Capacitance	V <sub>IN</sub> = 3dV	6	pF
C <sub>I/O</sub>	I/O Capacitance	V <sub>OUT</sub> = 3dV	7	pF

### NOTE:

- This parameter is guaranteed by device characterization, but not production tested.

## DC ELECTRICAL CHARACTERISTICS OVER THE OPERATING TEMPERATURE AND SUPPLY VOLTAGE RANGE (V<sub>DD</sub> = 3.3V ±5%)

Symbol	Parameter	Test Condition	Min.	Max.	Unit
I <sub>LI</sub>	Input Leakage Current	V <sub>DD</sub> = Max., V <sub>IN</sub> = 0V to V <sub>DD</sub>	—	5	μA
I <sub>LO</sub>	Output Leakage Current	$\overline{CS} \geq V_{IH}$ , V <sub>OUT</sub> = 0V to V <sub>DD</sub> , V <sub>DD</sub> = Max.	—	5	μA
V <sub>OL</sub>	Output Low Voltage	I <sub>OL</sub> = 5 mA, V <sub>DD</sub> = Min.	—	0.4	V
V <sub>OH</sub>	Output High Voltage	I <sub>OH</sub> = -5 mA, V <sub>DD</sub> = Min.	2.4	—	V

## DC ELECTRICAL CHARACTERISTICS OVER THE OPERATING TEMPERATURE AND SUPPLY VOLTAGE RANGE<sup>(1)</sup> (V<sub>DD</sub> = 3.3V ±5%, V<sub>HD</sub> = V<sub>DD</sub> - 0.2V, V<sub>LD</sub> = 0.2V)

Symbol	Parameter	Test Condition	71V509S66	71V509S50	Unit
I <sub>DD</sub>	Operating Power Supply Current	$\overline{CS} \leq V_{IL}$ , Outputs Open, V <sub>DD</sub> = Max., V <sub>IN</sub> ≥ V <sub>IH</sub> or ≤ V <sub>IL</sub> , f = f <sub>MAX</sub> <sup>(2)</sup>	150	120	mA
I <sub>SB</sub>	Standby Power Supply Current	$\overline{CS} \geq V_{IH}$ , Outputs Open, V <sub>DD</sub> = Max., V <sub>IN</sub> ≥ V <sub>IH</sub> or ≤ V <sub>IL</sub> , f = f <sub>MAX</sub> <sup>(2)</sup>	50	45	mA
I <sub>SB1</sub>	Full Standby Power Supply Current	$\overline{CS} \geq V_{HD}$ , Outputs Open, V <sub>DD</sub> = Max., V <sub>IN</sub> ≥ V <sub>HD</sub> or ≤ V <sub>LD</sub> , f = 0 <sup>(2)</sup>	10	10	mA

### NOTES:

- All values are maximum guaranteed values.
- At f = f<sub>MAX</sub>, address inputs are switching at 1/t<sub>CYC</sub> and CLK is cycling at 1/t<sub>CYC</sub>; f=0 means no input signals are changing.

## AC ELECTRICAL CHARACTERISTICS

( $V_{DD} = 3.3V \pm 5\%$ ,  $T_A = 0$  to  $70^\circ C$ )

Symbol	Parameter	IDT71V509S66		IDT71V509S50		Unit
		Min.	Max.	Min.	Max.	
<b>Clock Parameters</b>						
f <sub>MAX</sub>	Clock Frequency	—	66	—	50	MHz
t <sub>CYC</sub>	Clock Cycle Time	15	—	20	—	ns
t <sub>CH</sub>	Clock High Pulse Width	5	—	6	—	ns
t <sub>CL</sub>	Clock Low Pulse Width	5	—	6	—	ns
<b>Output Parameters</b>						
t <sub>CD</sub>	Clock High to Valid Data	—	9	—	10	ns
t <sub>CDC</sub>	Clock High to Data Change	2	—	2	—	ns
t <sub>CLZ</sub> <sup>(1)</sup>	Clock High to Output Active	2	—	2	—	ns
t <sub>CHZ</sub> <sup>(1)</sup>	Clock High to Data High-Z	2	5	2	6	ns
t <sub>OE</sub>	Output Enable Access Time	—	6	—	7	ns
t <sub>OLZ</sub> <sup>(1)</sup>	Output Enable Low to Data Active	0	—	0	—	ns
t <sub>OHZ</sub> <sup>(1)</sup>	Output Enable High to Data High-Z	—	5	—	6	ns
<b>Set Up Times</b>						
t <sub>SE</sub>	Clock Enable Setup Time	2	—	2.5	—	ns
t <sub>SA</sub>	Address Setup Time	2	—	2.5	—	ns
t <sub>SD</sub>	Data In Setup Time	2	—	2.5	—	ns
t <sub>SW</sub>	Write Enable Setup Time	2	—	2.5	—	ns
t <sub>SC</sub>	Chip Select Setup Time	2	—	2.5	—	ns
<b>Hold Times</b>						
t <sub>HE</sub>	Clock Enable Hold Time	1	—	1	—	ns
t <sub>HA</sub>	Address Hold Time	1	—	1	—	ns
t <sub>HD</sub>	Data In Hold Time	1	—	1	—	ns
t <sub>HW</sub>	Write Enable Hold Time	1	—	1	—	ns
t <sub>HC</sub>	Chip Select Hold Time	1	—	1	—	ns

**NOTES:**

1. Transition is measured  $\pm 200mV$  from steady-state.

## AC TEST CONDITIONS

Input Pulse Levels	0 to 3V
Input Rise/Fall Times	2ns
Input Timing Reference Levels	1.5V
Output Timing Reference Levels	1.5V
AC Test Load	See Figures 1 and 2

### AC TEST LOADS

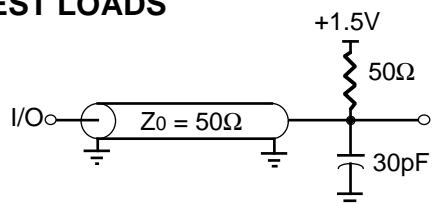


Figure 1. AC Test Load

3618 drw 04

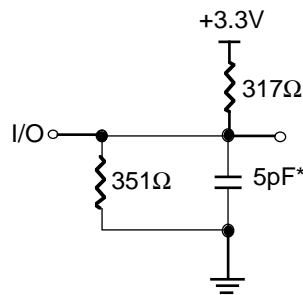
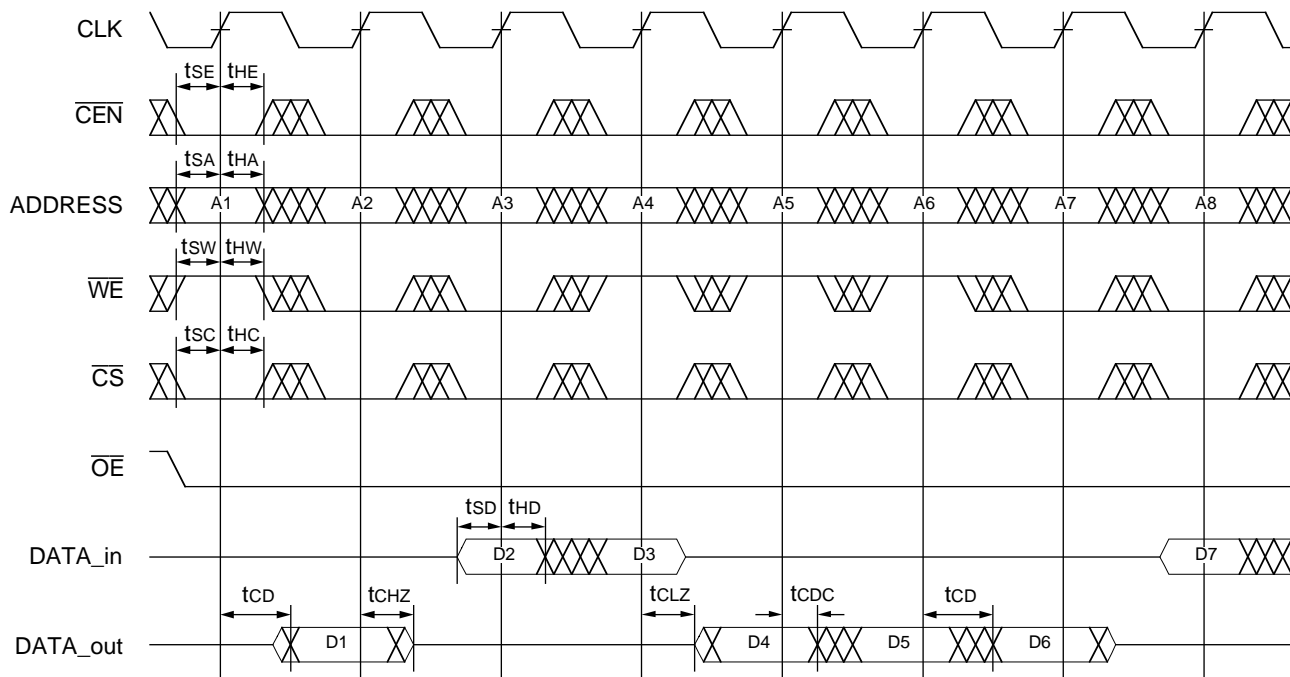


Figure 2. AC Test Load  
(for t<sub>OHZ</sub>, t<sub>CHZ</sub>, t<sub>OLZ</sub>, and t<sub>DC1</sub>)

\* Including scope and jig

3618 drw 05

### TIMING WAVEFORM OF READ AND WRITE CYCLES<sup>(1)</sup>

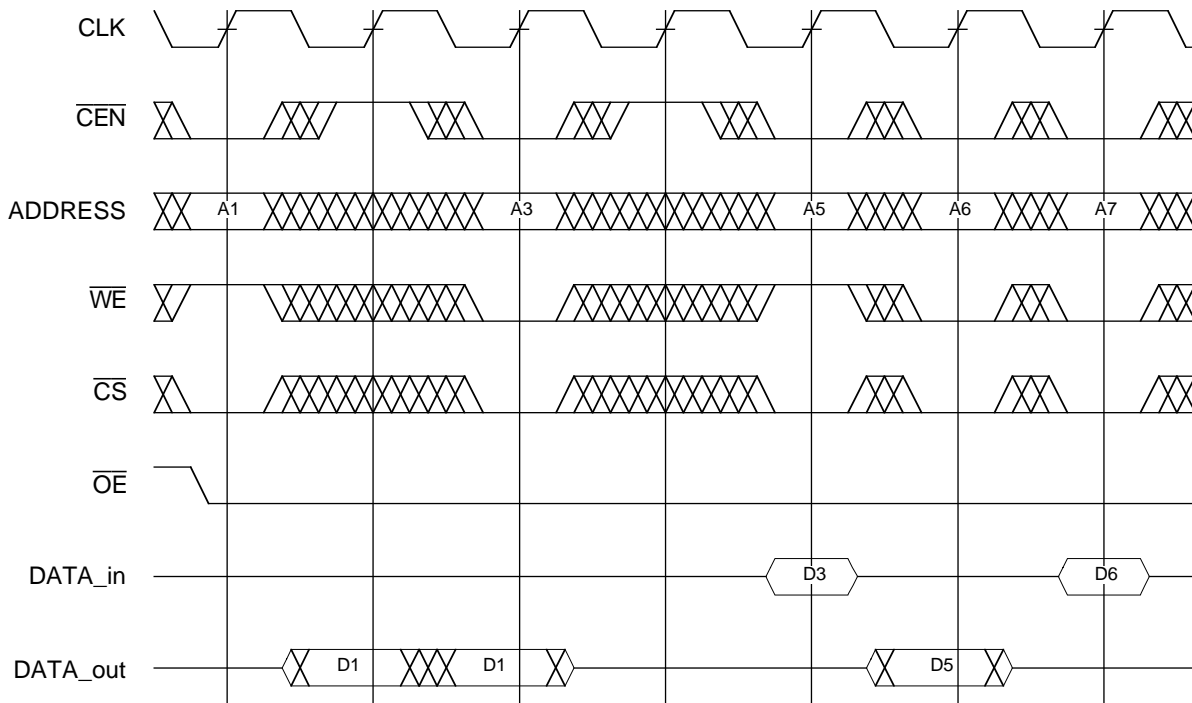


3618 drw 06

**NOTES:**

1. Dx represents the data for address Ax.
2. DATA\_in and DATA\_out together represent I/O(7:0).

### TIMING WAVEFORM OF $\overline{\text{CEN}}$ OPERATION<sup>(1)</sup>



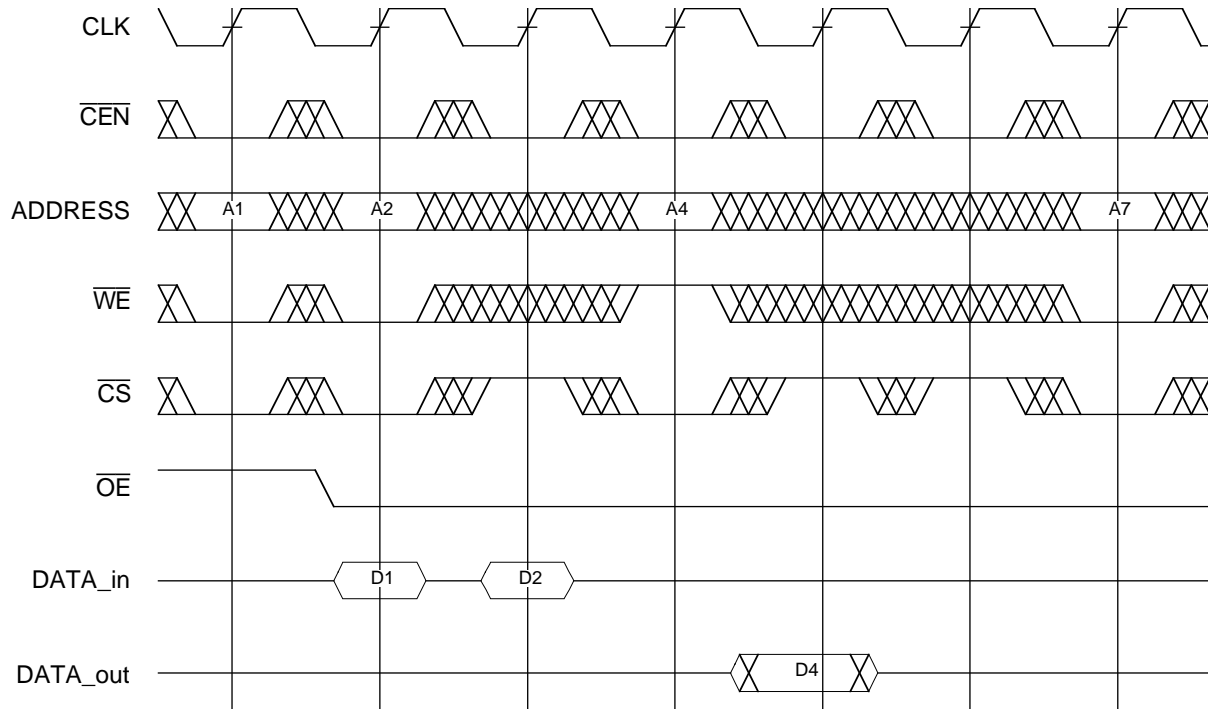
3618 drw 07

**NOTES:**

1. Dx represents the data for address Ax.
2. DATA\_in and DATA\_out together represent I/O(7:0).



### TIMING WAVEFORM OF $\overline{CS}$ OPERATION<sup>(1)</sup>

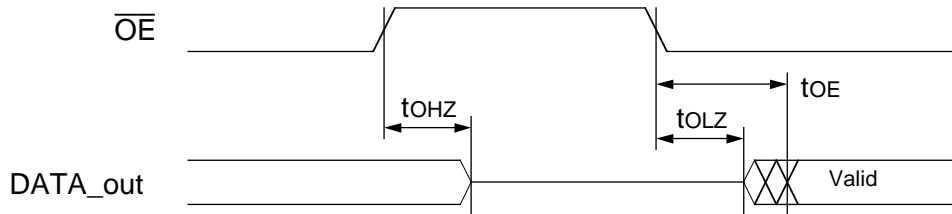


3618 drw 08

**NOTES:**

1. Dx represents the data for address Ax.
2. DATA\_in and DATA\_out together represent I/O(7:0).

### TIMING WAVEFORM OF $\overline{OE}$ OPERATION



**NOTES:**

1. A read operation is assumed to be in progress.

3618 drw 09

### ORDERING INFORMATION

IDT	71V509	S	X	Y	
	Device Type	Power	Speed	Package	
					} Small Outline J-Bend, 44 pin (SO44-1)
				Y	
					} Clock Frequency in Megahertz
				50 66	

3618 drw 10