



Integrated Device Technology, Inc.

# CMOS STATIC RAM 16K (2K x 8-BIT)

IDT 6116SA  
IDT 6116LA

T-46-23-12

### FEATURES:

- Optimized for fast RISC processors including the IDT79R3000
- High-speed
  - Military: 25/30/35/45/55/70/90/120/150ns (max.)
  - Commercial: 15/19/20/25/30/35/45ns (max.)
- Low-power operation
  - IDT6116SA
    - Active: 180mW (typ.)
    - Standby: 100µW (typ.)
  - IDT6116LA
    - Active: 160mW (typ.)
    - Standby: 20µW (typ.)
- Battery backup operation—2V data retention voltage (LA version only)
- Produced with advanced CEMOS™ high-performance technology
- CEMOS process virtually eliminates alpha particle soft-error rates
- Single 5V (±10%) power supply
- Input and output directly TTL-compatible
- Static operation: no clocks or refresh required
- Available in standard 24-pin DIP, 24-pin THINDIP and plastic DIP, 24-, 28- and 32-pin LCC, 24-pin SOIC and 24-lead CERPACK and Flatpack
- Military product compliant to MIL-STD-883, Class B
- Standard Military Drawing# 84036 is listed on this function. Refer to Section 2/page 2-4.

### DESCRIPTION:

The IDT6116SA/LA is a 16,384-bit high-speed static RAM organized as 2K x 8. It is fabricated using IDT's high-performance, high-reliability technology—CEMOS. This state-of-the-art technology, combined with innovative circuit design techniques, provides a cost-effective alternative to bipolar and fast NMOS memories. Timing parameters have been specified to meet the speed demands of the fastest IDT79R3000 RISC processors.

Access times as fast as 15ns are available with maximum power consumption of only 666mW. The circuit also offers a reduced power standby mode. When CS goes high, the circuit will automatically go to, and remain in, a standby power mode as long as CS remains high. In the standby mode, the low-power device consumes less than 20µW typically. This capability provides significant system level power and cooling savings. The low-power (LA) version also offers a battery backup data retention capability where the circuit typically consumes only 1µW to 4µW operating off a 2V battery.

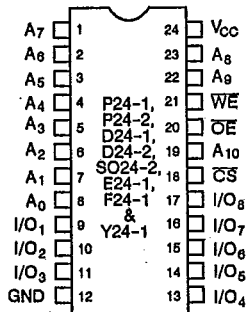
All inputs and outputs of the IDT6116SA/LA are TTL-compatible and operation is from a single 5V supply, simplifying system designs. Fully static asynchronous circuitry is used, requiring no clocks or refreshing for operation, providing equal access and cycle times for ease of use.

The IDT6116SA/LA is packaged in 24-pin 600 and 300 mil plastic or ceramic DIP, 24-, 28- and 32-pin leadless chip carriers, 24-lead CERPACK and flatpack, and a 24-lead gull-wing SOIC, providing high board-level packing densities.

Military grade product is manufactured in compliance to the latest version of MIL-STD-883, Class B, making it ideally suited to military temperature applications demanding the highest level of performance and reliability.

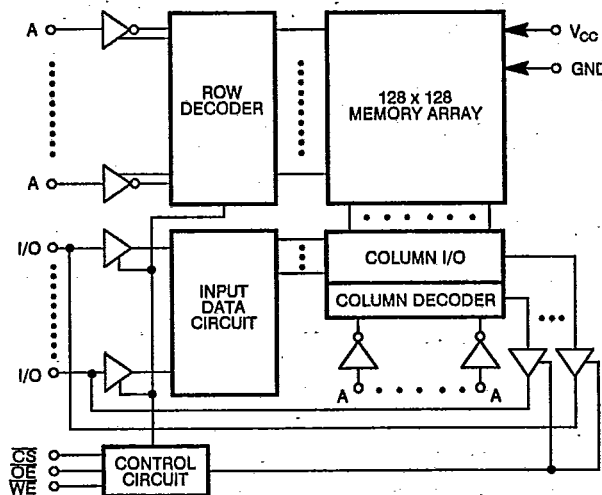


### PIN CONFIGURATION



DIP/SOIC/FLATPACK/CERPACK TOP VIEW

### FUNCTIONAL BLOCK DIAGRAM



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MILITARY AND COMMERCIAL TEMPERATURE RANGES

JANUARY 1989

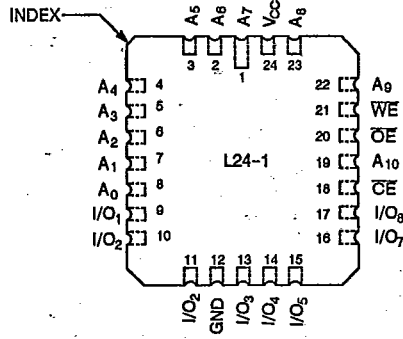
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S4-143

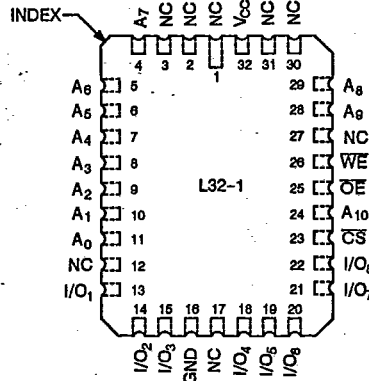
DSC-1003/-

T-46-23-12

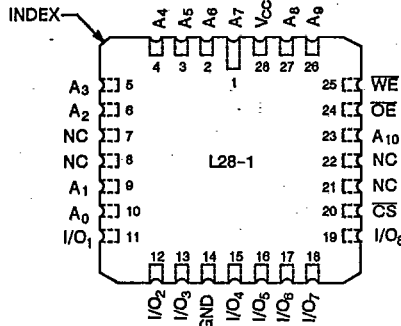
PIN CONFIGURATIONS



24-PIN LCC  
TOP VIEW

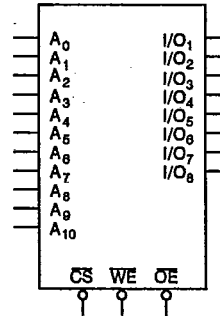


32-PIN LCC  
TOP VIEW



28-PIN LCC  
TOP VIEW

LOGIC SYMBOL



PIN NAMES

A <sub>0</sub> - A <sub>10</sub>	Address	WE	Write Enable
I/O <sub>1</sub> - I/O <sub>8</sub>	Data Input/Output	OE	Output Enable
CS	Chip Select	GND	Ground
V <sub>CC</sub>	Power		

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

SYMBOL	RATING	COMMERCIAL	MILITARY	UNIT
V <sub>TERM</sub>	Terminal Voltage with Respect to GND	-0.5 to +7.0	-0.5 to +7.0	V
T <sub>A</sub>	Operating Temperature	0 to +70	-55 to +125	°C
T <sub>BIAS</sub>	Temperature Under Bias	-55 to +125	-65 to +135	°C
T <sub>STG</sub>	Storage Temperature	-55 to +125	-65 to +150	°C
P <sub>T</sub>	Power Dissipation	1.0	1.0	W
I <sub>OUT</sub>	DC Output Current	50	50	mA

NOTE:

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.

RECOMMENDED OPERATING TEMPERATURE AND SUPPLY VOLTAGE

GRADE	AMBIENT TEMPERATURE	GND	V <sub>CC</sub>
Military	-55°C to +125°C	0V	5.0V ± 10%
Commercial	0°C to +70°C	0V	5.0V ± 10%

RECOMMENDED DC OPERATING CONDITIONS

SYMBOL	PARAMETER	MIN.	TYP.	MAX.	UNIT
V <sub>CC</sub>	Supply Voltage	4.5	5.0	5.5	V
GND	Supply Voltage	0	0	0	V
V <sub>IH</sub>	Input High Voltage	2.2	3.5	6.0	V
V <sub>IL</sub>	Input Low Voltage	-0.5 <sup>(1)</sup>	-	0.8	V
C <sub>L</sub>	Output Load	-	-	30	pF

NOTE:

1. V<sub>IL</sub> = -3.0V for pulse width less than 20ns.

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DC ELECTRICAL CHARACTERISTICS

V<sub>CC</sub> = 5.0V ±10%

SYMBOL	PARAMETER	TEST CONDITIONS	IDT6116SA			IDT6116LA			UNIT	
			MIN.	TYP. <sup>(1)</sup>	MAX.	MIN.	TYP. <sup>(1)</sup>	MAX.		
I <sub>IL</sub>	Input Leakage Current	V <sub>CC</sub> = Max., V <sub>IN</sub> = GND to V <sub>CC</sub>	MIL. COM'L.	- -	- -	10 5	- -	- -	5 2	μA
I <sub>LO</sub>	Output Leakage Current	V <sub>CC</sub> = Max. CS = V <sub>IH</sub> , V <sub>OUT</sub> = GND to V <sub>CC</sub>	MIL. COM'L.	- -	- -	10 5	- -	- -	5 2	μA
V <sub>OL</sub>	Output Low Voltage	I <sub>OL</sub> = 8mA, V <sub>CC</sub> = Min.	-	-	0.4	-	-	0.4	-	V
V <sub>OH</sub>	Output High Voltage	I <sub>OH</sub> = -4mA, V <sub>CC</sub> = Min.	2.4	-	-	2.4	-	-	-	V

NOTE:

1. Typical limits are at V<sub>CC</sub> = 5.0V, +25°C ambient.

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DC ELECTRICAL CHARACTERISTICS <sup>(1)</sup>

V<sub>CC</sub> = 5.0V ±10%, V<sub>LO</sub> = 0.2V, V<sub>HC</sub> = V<sub>CC</sub> - 0.2V

SYMBOL	PARAMETER	POWER	6116SA15 <sup>(2)</sup> /19 <sup>(2)</sup> /20 <sup>(2)</sup> 6116LA15 <sup>(2)</sup> /19 <sup>(2)</sup> /20 <sup>(2)</sup>		6116SA25/30 6116LA25/30		6116SA35 6116LA35		6116SA45/55 6116LA45/55		6116SA70/90 6116LA70/90		6116SA120/150 <sup>(3)</sup> 6116LA120/150 <sup>(3)</sup>		UNIT
			COM'L.	MIL.	COM'L.	MIL.	COM'L.	MIL.	COM'L.	MIL.	COM'L.	MIL.	COM'L.	MIL.	
I <sub>CC1</sub>	Operating Power Supply Current CS = V <sub>IL</sub> , Outputs Open, V <sub>CC</sub> = Max., f = 0	SA	125/110	-	100/80	110	80	90	80/-	90	-	90	-	90	mA
		LA	115/100	-	90/75	105	75	85	75/-	85	-	85	-	85	
I <sub>CC2</sub>	Dynamic Operating Current CS = V <sub>IL</sub> , Outputs Open, V <sub>CC</sub> = Max., f = f <sub>MAX</sub> <sup>(4)</sup>	SA	150/130	-	120/110	135	100	115	100/-	100	-	100	-	100/90	mA
		LA	140/120	-	110/105	125	95	105	90/-	95/90	-	90/85	-	85	
I <sub>SB</sub>	Standby Power Supply Current (TTL Level) CS ≥ V <sub>IH</sub> , V <sub>CC</sub> = Max., Outputs Open, f = f <sub>MAX</sub> <sup>(4)</sup>	SA	40	-	40/35	45	25	35	25/-	25	-	25	-	25	mA
		LA	35	-	35/30	40	25	30	20/-	20	-	20/15	-	15	
I <sub>SB1</sub>	Full Standby Power Supply Current (CMOS Level) CS ≥ V <sub>HC</sub> , V <sub>CC</sub> = Max., V <sub>IN</sub> ≥ V <sub>IH</sub> or V <sub>IN</sub> ≤ V <sub>LO</sub> , f = 0	SA	2	-	2	10	2	10	2/-	10	-	10	-	10	mA
		LA	0.1	-	0.1	0.9	0.1	0.9	0.1/-	0.9	-	0.9	-	0.9	

NOTES:

1. All values are maximum guaranteed values.
2. 0°C to +70°C temperature range only.
3. -55°C to +125°C temperature range only.
4. f<sub>MAX</sub> = 1/t<sub>RO</sub>

DATA RETENTION CHARACTERISTICS OVER ALL TEMPERATURE RANGES

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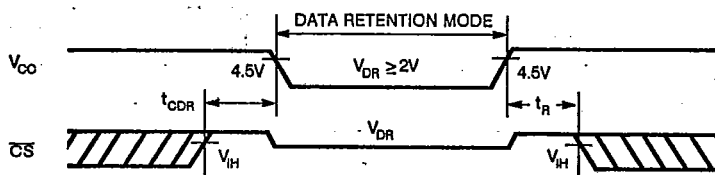
(LA Version Only)  $V_{LO} = 0.2V$ ,  $V_{HC} = V_{CC} - 0.2V$

SYMBOL	PARAMETER	TEST CONDITIONS	MIN.	TYP. (1)		MAX.		UNIT	
				$V_{CC} @ 2.0V$	$V_{CC} @ 3.0V$	$V_{CC} @ 2.0V$	$V_{CC} @ 3.0V$		
$V_{DR}$	$V_{CC}$ for Data Retention	-	2.0	-	-	-	-	V	
$I_{CCDR}$	Data Retention Current	$\overline{CS} \geq V_{HC}$ $V_{IN} \geq V_{HC}$ or $\leq V_{LC}$	MIL.	-	0.5	1.5	200	300	$\mu A$
			COM'L.	-	0.5	1.5	20	30	$\mu A$
$t_{CDR}^{(3)}$	Chip Deselect to Data Retention Time		0	-	-	-	-	ns	
$t_R^{(3)}$	Operation Recovery Time		$t_{RO}^{(2)}$	-	-	-	-	ns	
$ I_{IL} $	Input Leakage Current		-	-	-	2	-	$\mu A$	

NOTES:

- $T_A = +25^\circ C$
- $t_{RO}$  = Read Cycle Time
- This parameter is guaranteed, but not tested.

LOW  $V_{CC}$  DATA RETENTION WAVEFORM



AC TEST CONDITIONS

Input Pulse Levels	GND to 3.0V
Input Rise/Fall Times	5ns
Input Timing Reference Levels	1.5V
Output Reference Levels	1.5V
Output Load	See Figures 1 and 2

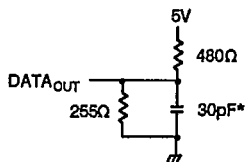


Figure 1. Output Load

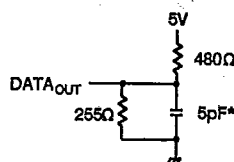


Figure 2. Output Load  
(for  $t_{OLZ}$ ,  $t_{CLZ}$ ,  $t_{OHZ}$ ,  
 $t_{WHZ}$ ,  $t_{CHZ}$ ,  $t_{OW}$ )

\*Including scope and jig.

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AC ELECTRICAL CHARACTERISTICS (V<sub>CC</sub> = 5V ±10%, All Temperature Ranges)

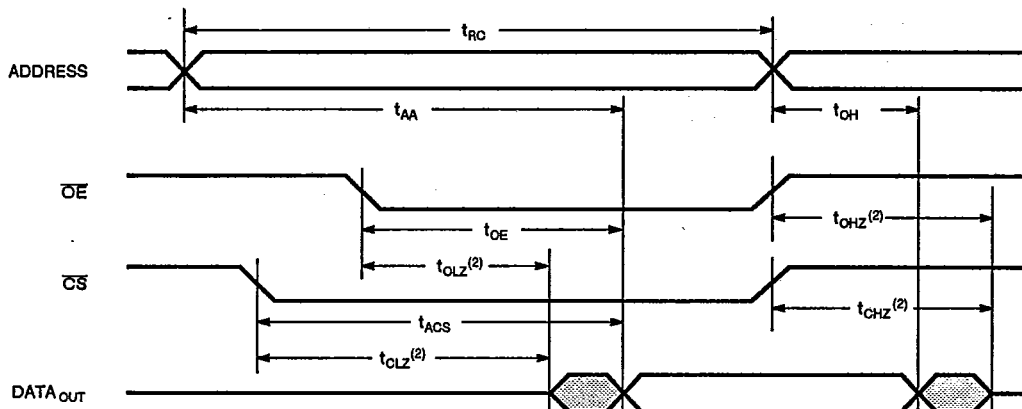
SYMBOL	PARAMETER	6116SA15/19 <sup>(1)</sup> /20 <sup>(1)</sup>		6116SA25/30		6116SA35/45		6116SA55 <sup>(2)</sup>		6116SA70/90 <sup>(2)</sup>		6116SA120/150 <sup>(2)</sup>		UNIT
		MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	
READ CYCLE														
t <sub>RC</sub>	Read Cycle Time	15/19/20		25/30	-	35/45	-	55	-	70/90	-	120/150	-	ns
t <sub>AA</sub>	Address Access Time	-	15/19/20	-	25/29	-	35/45	-	55	-	70/90	-	120/150	ns
t <sub>ACS</sub>	Chip Select Access Time	-	15/20/20	-	25/30	-	35/45	-	50	-	65/90	-	120/150	ns
t <sub>CLZ</sub>	Chip Select to Output in Low Z <sup>(3)</sup>	5		5	-	5	-	5	-	5	-	5	-	ns
t <sub>OE</sub>	Output Enable to Output Valid	-	10	-	13/15	-	20/25	-	40	-	50/65	-	80/100	ns
t <sub>OLZ</sub>	Output Enable to Output in Low Z <sup>(3)</sup>	0		5	-	5	-	5	-	5	-	5	-	ns
t <sub>CHZ</sub>	Chip Deselect to Output in High Z <sup>(3)</sup>	-	10/11/11	-	12/13	-	15/20	-	30	-	35/40	-	40	ns
t <sub>OHZ</sub>	Output Disable to Output in High Z <sup>(3)</sup>	-	8/8/9	-	10/12	-	13/15	-	30	-	35/40	-	40	ns
t <sub>OH</sub>	Output Hold from Address Change	5		5	-	5	-	5	-	5	-	5	-	ns

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NOTES:

- 0°C to +70°C temperature range only.
- 55°C to +125°C temperature range only.
- This parameter guaranteed but not tested.

TIMING WAVEFORM OF READ CYCLE NO. 1<sup>(1)</sup>

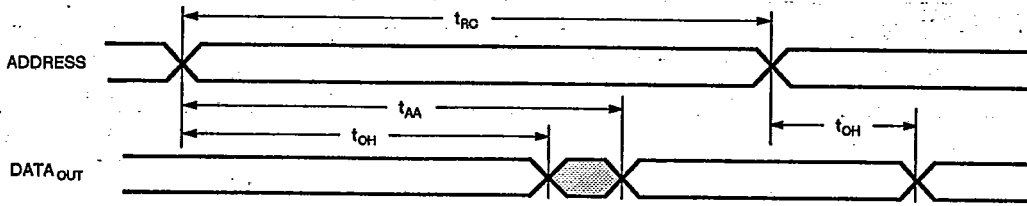


NOTES:

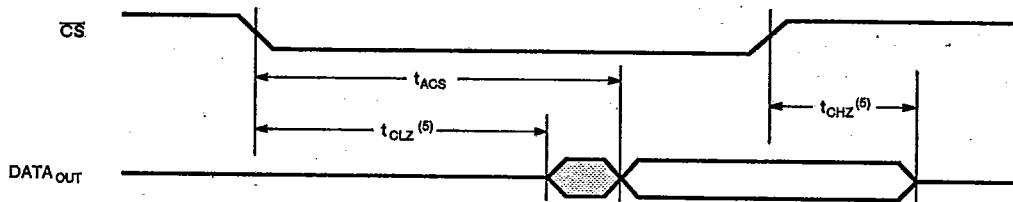
- WE is high for read cycle.
- Transition is measured ±500mV from steady state with 5pF load (including scope and jig).

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TIMING WAVEFORM OF READ CYCLE NO. 2 (1, 2, 4)



TIMING WAVEFORM OF READ CYCLE NO. 3 (1, 3, 4)



NOTES:

1.  $\overline{WE}$  is high for read cycle.
2. Device is continuously selected,  $\overline{CS} = V_{IL}$ .
3. Address valid prior to or coincident with  $\overline{CS}$  transition low.
4.  $\overline{OE} = V_{IL}$ .
5. Transition is measured  $\pm 500mV$  from steady state with 5pF load (including scope and jig).

AC ELECTRICAL CHARACTERISTICS (V<sub>CC</sub> = 5V ±10%, All Temperature Ranges)

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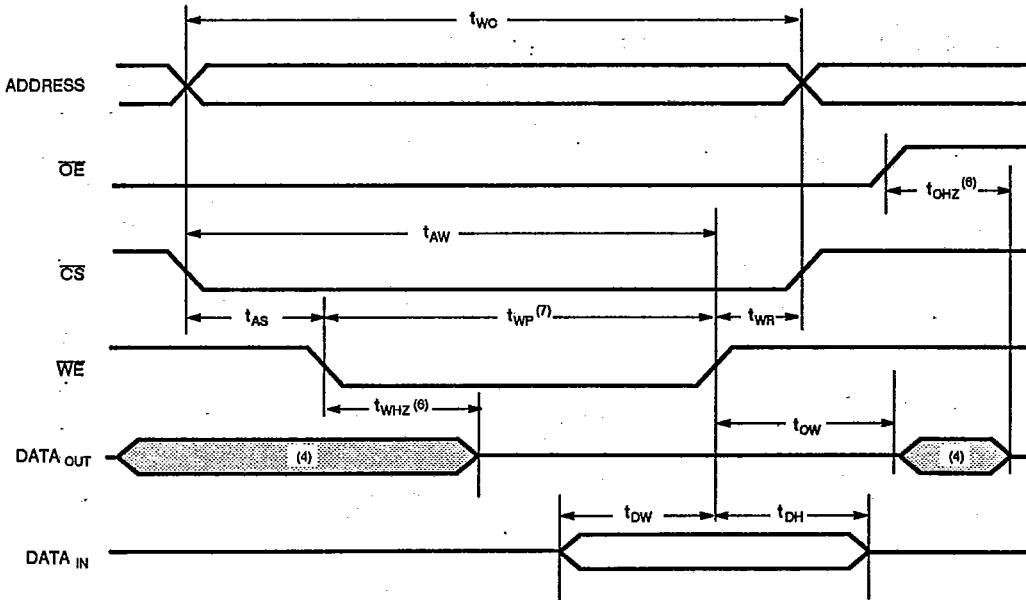
SYMBOL	PARAMETER	6116SA15/19 <sup>(1)</sup> /20 <sup>(1)</sup> 6116LA15/19 <sup>(1)</sup> /20 <sup>(1)</sup>		6116SA25/30 6116LA25/30		6116SA35/45 6116LA35/45		6116SA55 <sup>(2)</sup> 6116LA55 <sup>(2)</sup>		6116SA70/90 <sup>(2)</sup> 6116LA70/90 <sup>(2)</sup>		6116SA120/150 <sup>(2)</sup> 6116LA120/150 <sup>(2)</sup>		UNIT
		MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	
<b>WRITE CYCLE</b>														
t <sub>WC</sub>	Write Cycle Time	15/19/20		25/30	-	35/45	-	55	-	70/90	-	120/150	-	ns
t <sub>CW</sub>	Chip Select to End of Write	13/15/15		17/20	-	25/30	-	40	-	40/55	-	70/90	-	ns
t <sub>AW</sub>	Address Valid to End of Write	14/15/15		17/20	-	25/30	-	45	-	65/80	-	105/120	-	ns
t <sub>AS</sub>	Address Set-up Time	0		0	-	0	-	5	-	15	-	20	-	ns
t <sub>WP</sub>	Write Pulse Width	12/12/15		15	-	20/25	-	40	-	40/55	-	70/90	-	ns
t <sub>WR</sub>	Write Recovery Time	0		0	-	0	-	5	-	5	-	5/10	-	ns
t <sub>OHZ</sub>	Output Disable to Output in High Z <sup>(3)</sup>	-	5/9/9	-	16/18	-	20/25	-	30	-	35/40	-	40	ns
t <sub>WHZ</sub>	Write to Output in High Z <sup>(3)</sup>	-	7/8/8	-	16/18	-	20/25	-	30	-	35/40	-	40	ns
t <sub>DW</sub>	Data to Write Time Overlap	12		13/14	-	15/20	-	25	-	30	-	35/40	-	ns
t <sub>DH</sub>	Data Hold from Write Time <sup>(4)</sup>	0		0	-	0	-	5	-	5	-	5/10	-	ns
t <sub>OW</sub>	Output Active from End of Write <sup>(3,4)</sup>	0		0	-	0	-	0	-	0	-	0	-	ns

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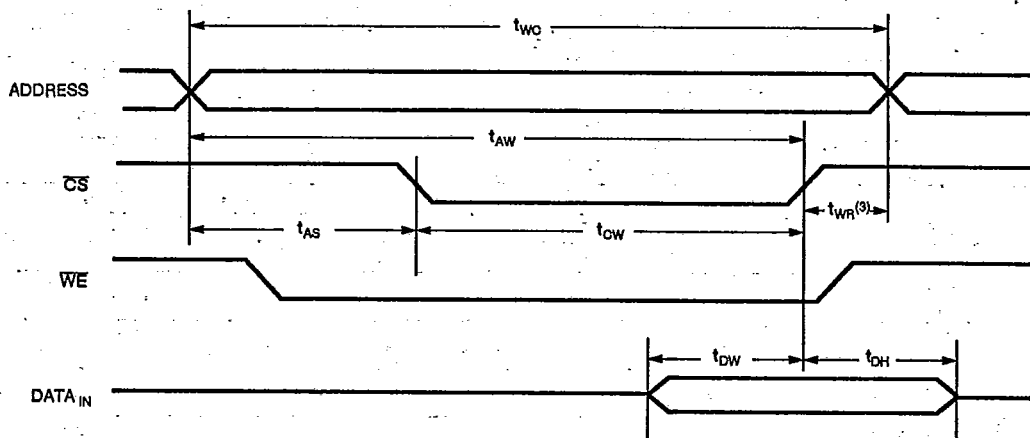
NOTES:

- 0°C to +70°C temperature range only.
- 55°C to +125°C temperature range only.
- This parameter guaranteed but not tested.
- The specification for t<sub>DH</sub> must be met by the device supplying write data to the RAM under all operating conditions. Although t<sub>DH</sub> and t<sub>OW</sub> values will vary over voltage and temperature, the actual t<sub>DH</sub> will always be smaller than the actual t<sub>OW</sub>.

TIMING WAVEFORM OF WRITE CYCLE NO. 1, (WE CONTROLLED TIMING)<sup>(1,2,3,7)</sup>



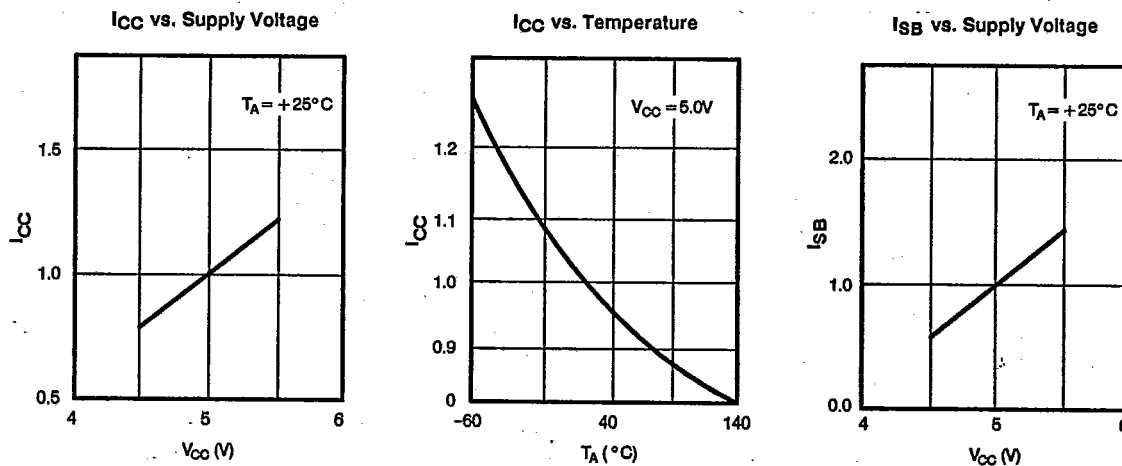
TIMING WAVEFORM OF WRITE CYCLE NO. 2, ( $\overline{CS}$  CONTROLLED TIMING)<sup>(1, 2, 3, 5)</sup> **T-46-23-12**



NOTES:

1. WE must be high during all address transitions.
2. A write occurs during the overlap ( $t_{OW}$  or  $t_{WP}$ ) of a low  $\overline{CS}$  and a low WE.
3.  $t_{WR}$  is measured from the earlier of  $\overline{CS}$  or WE going high to the end of the write cycle.
4. During this period, the I/O pins are in the output state, and the input signals must not be applied.
5. If the  $\overline{CS}$  low transition occurs simultaneously with or after the WE low transition, the outputs remain in the high impedance state.
6. Transition is measured  $\pm 500\text{mV}$  from steady state with a 5pF load (including scope and jig).
7. If  $\overline{OE}$  is low during a WE controlled write cycle, the write pulse width must be the larger of  $t_{WP}$  or  $(t_{WHZ} + t_{DW})$  to allow the I/O drivers to turn off and data to be placed on the bus for the required  $t_{DW}$ . If  $\overline{OE}$  is high during a WE controlled write cycle, this requirement does not apply and the write pulse can be as short as the specified  $t_{WP}$ .

NORMALIZED TYPICAL DC AND AC CHARACTERISTICS



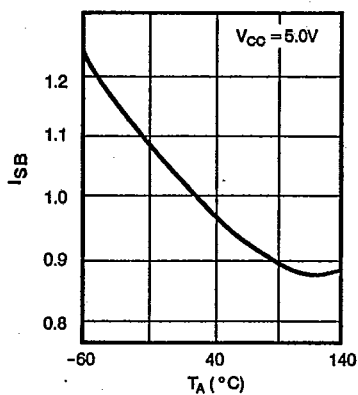


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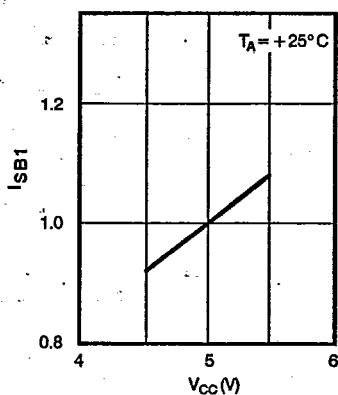
NORMALIZED TYPICAL DC AND AC CHARACTERISTICS

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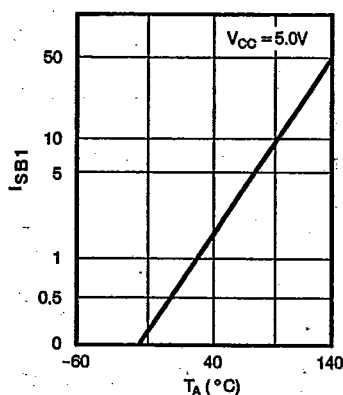
I<sub>SB</sub> vs. Temperature



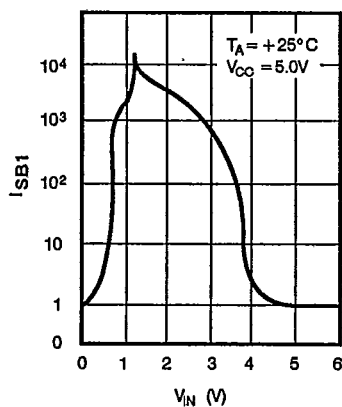
I<sub>SB1</sub> vs. Supply Voltage



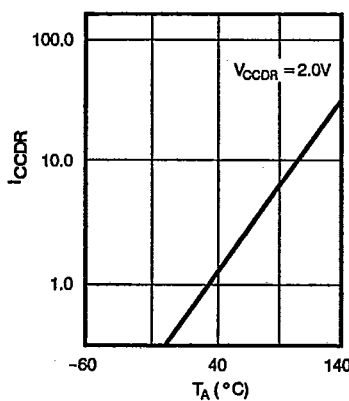
I<sub>SB1</sub> vs. Temperature



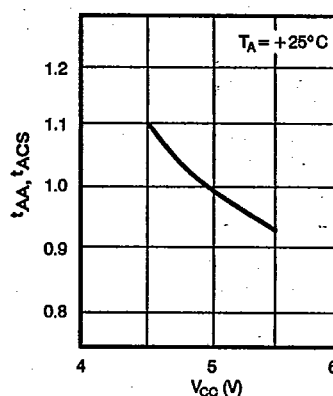
I<sub>SB1</sub> vs. V<sub>IN</sub>



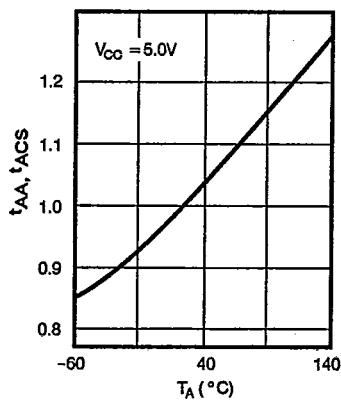
I<sub>CCDR</sub> vs. Temperature



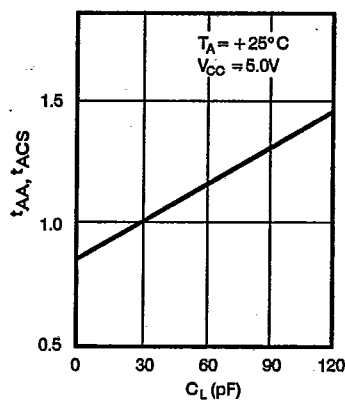
t<sub>AA</sub>, t<sub>ACS</sub> vs. Supply Voltage



t<sub>AA</sub>, t<sub>ACS</sub> vs. Temperature



t<sub>AA</sub>, t<sub>ACS</sub> vs. Output Loading



INTEGRATED DEVICE

14E D ■ 4825771 0003417 T ■

IDT6116SA/IDT6116LA CMOS  
STATIC RAM 16K (2K x 8-BIT)

MILITARY AND COMMERCIAL TEMPERATURE RANGES

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TRUTH TABLE

MODE	$\overline{CS}$	$\overline{OE}$	$\overline{WE}$	I/O
Standby	H	X	X	High Z
Read	L	L	H	DATA <sub>OUT</sub>
Read	L	H	H	High Z
Write	L	X	L	DATA <sub>IN</sub>

CAPACITANCE ( $T_A = +25^\circ\text{C}, f = 1.0\text{MHz}$ )

SYMBOL	PARAMETER <sup>(1)</sup>	CONDITIONS	MAX.	UNIT
C <sub>IN</sub>	Input Capacitance	V <sub>IN</sub> = 0V	8	pF
C <sub>OUT</sub>	Output Capacitance	V <sub>OUT</sub> = 0V	8	pF

NOTE:

1. This parameter is determined by device characterization, but is not production tested.

PINOUT CONFIGURATION  
16K CMOS SRAM  
IDT6116 (2K x 8)

FUNCTION	LOGIC SYMBOL	PIN NUMBER		
		24 DIP/ SOIC/ LCC/ FLATPACK	28 LCC	32 LCC
Address Line	A <sub>7</sub>	1	1	4
Address Line	A <sub>6</sub>	2	2	5
Address Line	A <sub>5</sub>	3	3	6
Address Line	A <sub>4</sub>	4	4	7
Address Line	A <sub>3</sub>	5	5	8
Address Line	A <sub>2</sub>	6	6	9
Address Line	A <sub>1</sub>	7	9	10
Address Line	A <sub>0</sub>	8	10	11
Input/Output	I/O <sub>1</sub>	9	11	13
Input/Output	I/O <sub>2</sub>	10	12	14
Input/Output	I/O <sub>3</sub>	11	13	15
Power Ground	GND	12	14	16
Input/Output	I/O <sub>4</sub>	13	15	18
Input/Output	I/O <sub>5</sub>	14	16	19
Input/Output	I/O <sub>6</sub>	15	17	20
Input/Output	I/O <sub>7</sub>	16	18	21
Input/Output	I/O <sub>8</sub>	17	19	22
Chip Select/ Data Retention	$\overline{CS}$	18	20	23
Address Line	A <sub>10</sub>	19	23	24
Output Enable	$\overline{OE}$	20	24	25
Write Enable	$\overline{WE}$	21	25	26
Address Line	A <sub>9</sub>	22	26	28
Address Line	A <sub>8</sub>	23	27	29
Power Supply	V <sub>CC</sub>	24	28	32

THERMAL RESISTANCE (Typical)

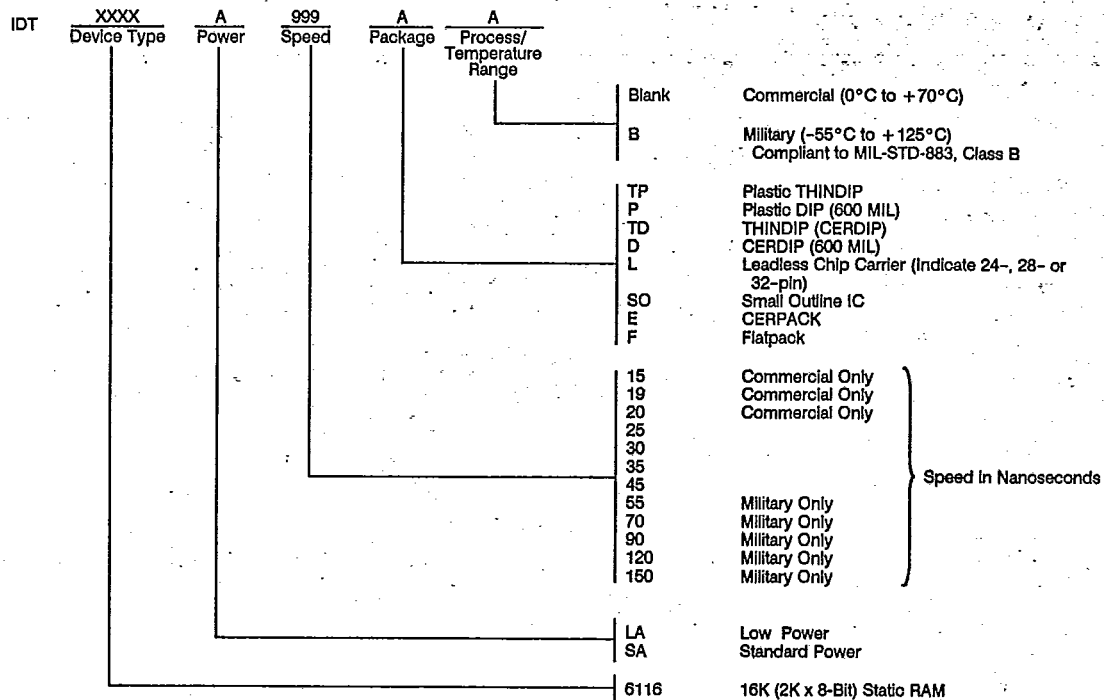
PACKAGE	PIN COUNT	$\theta_{JA}$	$\theta_{JC}$	UNIT
300 MIL PLASTIC DIP	24	54-58	28-32	°C/ WATT
600 MIL PLASTIC DIP	24	53-56	25-30	
300 MIL CERDIP	24	48-52	24-28	
600 MIL CERDIP	24	50-55	17-25	
FLATPACK	24	85-90	24-28	
LCC	24	85-110	30-45	
LCC	28	85-90	28-35	
LCC	32	80-90	25-35	
SOIC	24	45-70	25-30	

IDT6116SA/IDT6116LA CMOS  
STATIC RAM 16K (2K x 8-BIT)

MILITARY AND COMMERCIAL TEMPERATURE RANGES

ORDERING INFORMATION

T-46-23-12



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