



Integrated Device Technology, Inc.

# CMOS STATIC RAM 16K (16K x 1-BIT)

IDT6167SA  
IDT6167LA

## FEATURES:

- High-speed (equal access and cycle time)
  - Military: 15/20/25/35/45/55/70/85/100ns (max.)
  - Commercial: 15/20/25/35ns (max.)
- Low power consumption
- Battery backup operation — 2V data retention voltage (IDT6167LA only)
- Available in 20-pin CERDIP and Plastic DIP, and 20-pin SOJ
- Produced with advanced CMOS high-performance technology
- CMOS process virtually eliminates alpha particle soft-error rates
- Separate data input and output
- Military product compliant to MIL-STD-883, Class B

## DESCRIPTION:

The IDT6167 is a 16,384-bit high-speed static RAM organized as 16K x 1. The part is fabricated using IDT's high-performance, high reliability CMOS technology.

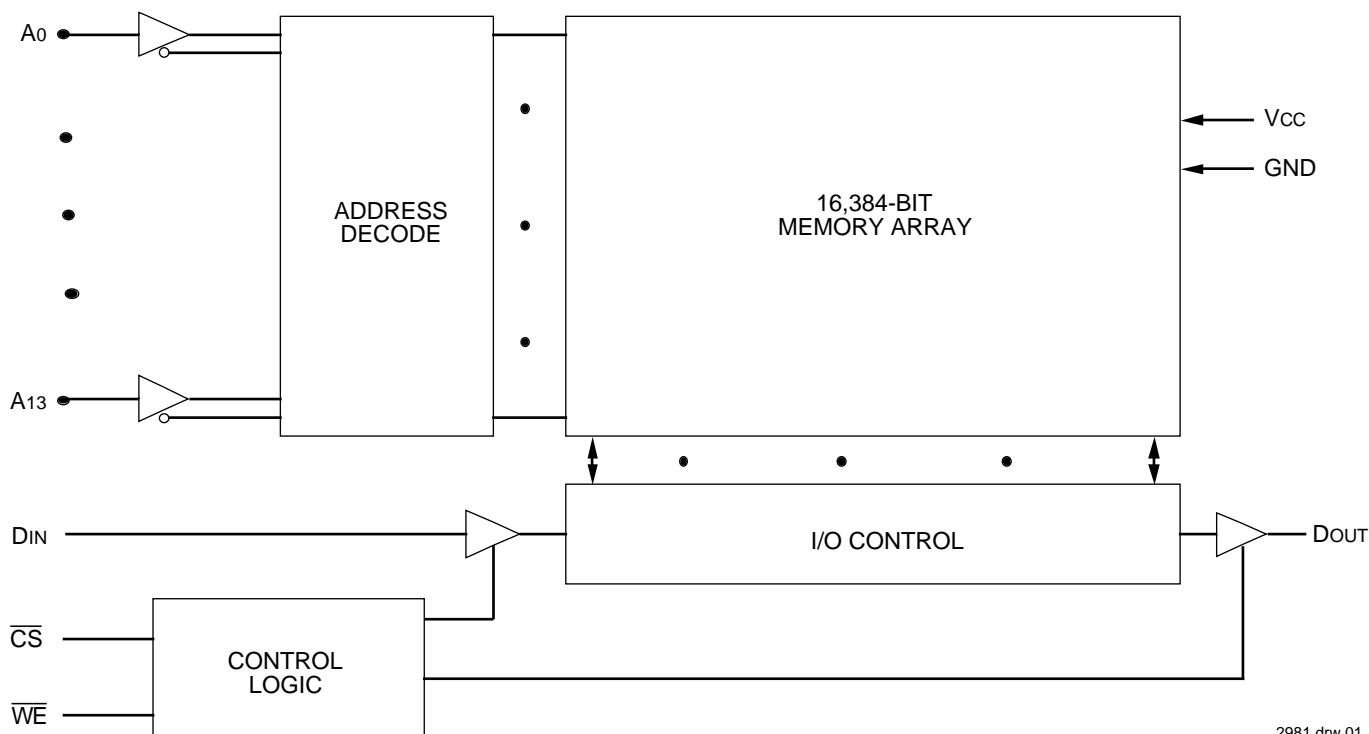
Access times as fast as 15ns are available. The circuit also offers a reduced power standby mode. When  $\overline{CS}$  goes HIGH, the circuit will automatically go to, and remain in, a standby mode as long as  $\overline{CS}$  remains HIGH. This capability provides significant system-level power and cooling savings. The low-power (LA) version also offers a battery backup data retention capability where the circuit typically consumes only 1 $\mu$ W operating off a 2V battery.

All inputs and the output of the IDT6167 are TTL-compatible and operate from a single 5V supply, thus simplifying system designs.

The IDT6167 is packaged in a space-saving 20-pin, 300 mil Plastic DIP or CERDIP, Plastic 20-pin SOJ, providing high board-level packing densities.

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

## FUNCTIONAL BLOCK DIAGRAM



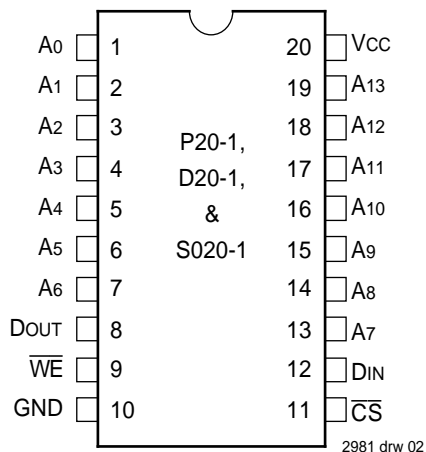
2981 drw 01

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**MILITARY AND COMMERCIAL TEMPERATURE RANGES**

**MARCH 1996**

## PIN CONFIGURATIONS



DIP/SOJ  
TOP VIEW

## PIN DESCRIPTIONS

A0–A13	Address Inputs
$\overline{CS}$	Chip Select
$\overline{WE}$	Write Enable
VCC	Power
DIN	DATAIN
DOUT	DATAOUT
GND	Ground

2981 tbl 01

## TRUTH TABLE (1)

Mode	$\overline{CS}$	$\overline{WE}$	Output	Power
Standby	H	X	High-Z	Standby
Read	L	H	DATAOUT	Active
Write	L	L	High-Z	Active

**NOTE:**

1. H = V<sub>IH</sub>, L = V<sub>IL</sub>, X = Don't Care.

2981 tbl 02

## RECOMMENDED OPERATING TEMPERATURE AND SUPPLY VOLTAGE

Grade	Temperature	GND	V <sub>CC</sub>
Military	–55°C to +125°C	0V	5V ± 10%
Commercial	0°C to +70°C	0V	5V ± 10%

2981 tbl 06

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

Symbol	Rating	Com'l.	Mil.	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:**

2981 tbl 03

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.

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

Symbol	Parameter <sup>(1)</sup>	Conditions	Max.	Unit
C <sub>IN</sub>	Input Capacitance	V <sub>IN</sub> = 0V	7	pF
C <sub>OUT</sub>	Output Capacitance	V <sub>OUT</sub> = 0V	7	pF

**NOTE:**

2981 tbl 04

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

## 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	—	6.0	V
V <sub>IL</sub>	Input Low Voltage	–0.5 <sup>(1)</sup>	—	0.8	V

**NOTE:**

2981 tbl 05

1. V<sub>IL</sub> (min.) = –3.0V for pulse width less than 20ns, once per cycle.

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

( $V_{CC} = 5.0V \pm 10\%$ ,  $V_{LC} = 0.2V$ ,  $V_{HC} = V_{CC} - 0.2V$ )

Symbol	Parameter	Power	6167SA/LA15		6167SA/LA20		6167SA/LA25		Unit
			Com'l.	Mil.	Com'l.	Mil.	Com'l.	Mil.	
ICC1	Operating Power Supply Current $\overline{CS} \leq V_{IL}$ , Outputs Open, $V_{CC} = \text{Max.}$ , $f = 0^{(3)}$	SA	90	90	90	90	90	90	mA
		LA	55	60	55	60	55	60	
ICC2	Dynamic Operating Current $\overline{CS} \leq V_{IL}$ , Outputs Open, $V_{CC} = \text{Max.}$ , $f = f_{MAX}^{(3)}$	SA	120	130	100	110	100	100	mA
		LA	100	110	80	85	70	75	
ISB	Standby Power Supply Current (TTL Level) $\overline{CS} \geq V_{IH}$ , Outputs Open, $V_{CC} = \text{Max.}$ , $f = f_{MAX}^{(3)}$	SA	50	50	35	35	35	35	mA
		LA	35	35	30	30	25	25	
ISB1	Full Standby Power Supply Current (CMOS Level) $\overline{CS} \geq V_{HC}$ , $V_{CC} = \text{Max.}$ $V_{IN} \geq V_{HC}$ or $V_{IN} \leq V_{LC}$ , $f = 0^{(3)}$	SA	5	10	5	10	5	10	mA
		LA	0.9	2	0.05	2	0.05	0.9	

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

( $V_{CC} = 5.0V \pm 10\%$ ,  $V_{LC} = 0.2V$ ,  $V_{HC} = V_{CC} - 0.2V$ )

Symbol	Parameter	Power	6167SA/LA35		6167SA/LA45 <sup>(2)</sup>		6167SA/LA55 <sup>(2)</sup>		6167SA/LA70 <sup>(2)</sup>		Unit
			Com'l.	Mil.	Com'l.	Mil.	Com'l.	Mil.	Com'l.	Mil.	
ICC1	Operating Power Supply Current $\overline{CS} \leq V_{IL}$ , Outputs Open, $V_{CC} = \text{Max.}$ , $f = 0^{(3)}$	SA	90	90	—	90	—	90	—	90	mA
		LA	55	60	—	60	—	60	—	60	
ICC2	Dynamic Operating Current $\overline{CS} \leq V_{IL}$ , Outputs Open, $V_{CC} = \text{Max.}$ , $f = f_{MAX}^{(3)}$	SA	100	100	—	100	—	100	—	100	mA
		LA	65	70	—	65	—	60	—	60	
ISB	Standby Power Supply Current (TTL Level) $\overline{CS} \geq V_{IH}$ , Outputs Open, $V_{CC} = \text{Max.}$ , $f = f_{MAX}^{(3)}$	SA	35	35	—	35	—	35	—	35	mA
		LA	20	20	—	20	—	20	—	15	
ISB1	Full Standby Power Supply Current (CMOS Level) $\overline{CS} \geq V_{HC}$ , $V_{CC} = \text{Max.}$ $V_{IN} \geq V_{HC}$ or $V_{IN} \leq V_{LC}$ , $f = 0^{(3)}$	SA	5	10	—	10	—	10	—	10	mA
		LA	0.05	0.9	—	0.9	—	0.9	—	0.9	

**NOTES:**

1. All values are maximum guaranteed values.
2.  $-55^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$  temperature range only. Also available; 85ns and 100ns Military devices.
3.  $f_{MAX} = 1/\text{trc}$ , only address inputs cycling at  $f_{MAX}$ .  $f = 0$  means no Address inputs change.

2981 tbl 07

## DC ELECTRICAL CHARACTERISTICS

VCC = 5.0V ± 10%

Symbol	Parameter	Test Condition	IDT6167SA		IDT6167LA		Unit	
			Min.	Max.	Min.	Max.		
ILI	Input Leakage Current	VCC = Max., VIN = GND to VCC	MIL	—	10	—	5	μA
			COM'L	—	5	—	2	
ILO	Output Leakage Current	VCC = Max., $\overline{CS} = V_{IH}$ , VOUT = GND to VCC	MIL	—	10	—	5	μA
			COM'L	—	5	—	2	
VOL	Output Low Voltage	IoL = 8mA, VCC = Min.	—	0.4	—	0.4	V	
VOH	Output High Voltage	IoH = -4mA, VCC = Min.	2.4	—	2.4	—	V	

2981 tbl 08

## DATA RETENTION CHARACTERISTICS OVER ALL TEMPERATURE RANGES

(LA Version Only) VLC = 0.2V, VHC = VCC - 0.2V

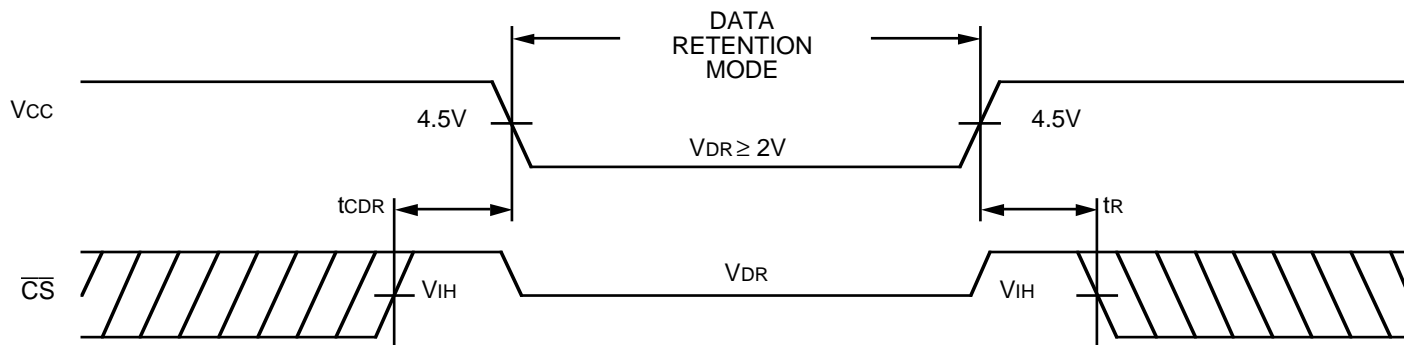
Symbol	Parameter	Test Condition	Min.	Typ. <sup>(1)</sup> VCC @		Max. VCC @		Unit
				2.0v	3.0V	2.0V	3.0V	
VDR	VCC for Data Retention	—	2.0	—	—	—	—	V
ICCDR	Data Retention Current	MIL. COM'L.	—	0.5	1.0	200	300	μA
			—	0.5	1.0	20	30	
tCDR	Chip Deselect to Data Retention Time	$\overline{CS} \geq V_{HC}$ VIN ≥ VHC or ≤ VLC	0	—	—	—	—	ns
tR <sup>(3)</sup>	Operation Recovery Time		tRC <sup>(2)</sup>	—	—	—	—	ns
ILI  <sup>(3)</sup>	Input Leakage Current	—	—	—	—	2	2	μA

### NOTES:

- TA = +25°C.
- tRC = Read Cycle Time.
- This parameter is guaranteed by device characterization, but is not production tested.

2981 tbl 09

## LOW VCC DATA RETENTION WAVEFORM



2981 drw 03

## 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
AC Test Load	See Figures 1 and 2

2981 tbl 10

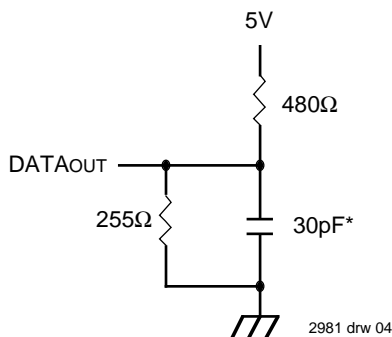


Figure 1. AC Test Load

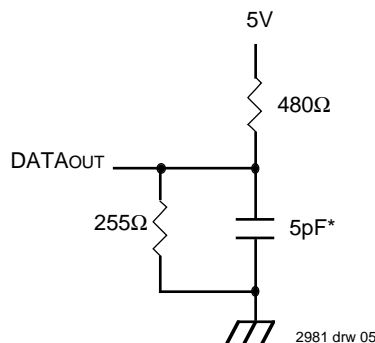


Figure 2. AC Test Load  
(for tCLZ, tCHZ, tWHZ and tOW)

\*Includes scope and jig.

## AC ELECTRICAL CHARACTERISTICS (V<sub>CC</sub> = 5.0V ± 10%, All Temperature Ranges)

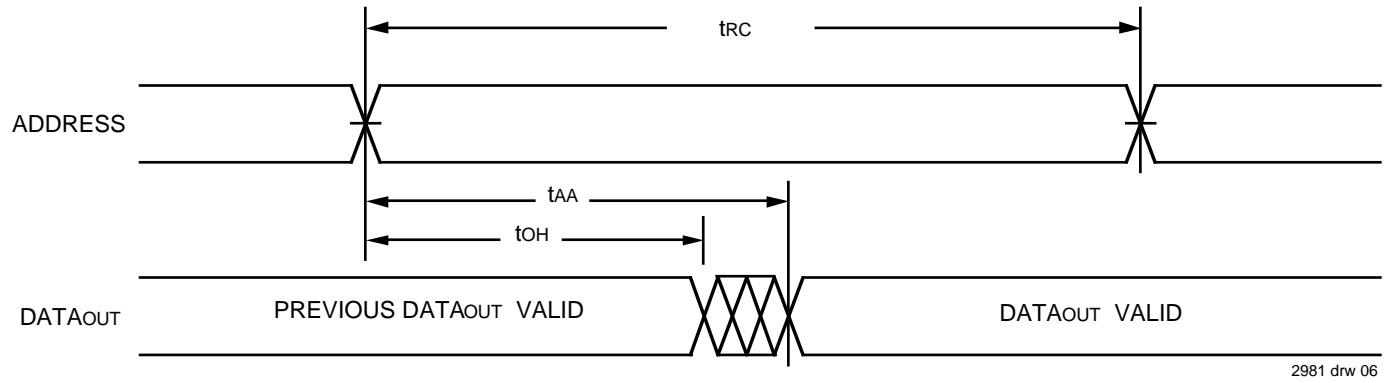
Symbol	Parameter	6167SA15 6167LA15		6167SA20/25 6167LA20/25		6167SA35/45 <sup>(1)</sup> 6167LA35/45 <sup>(1)</sup>		6167SA55 <sup>(1)</sup> /70 <sup>(1)</sup> 6167LA55 <sup>(1)</sup> /70 <sup>(1)</sup>		Unit
		Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	
<b>Read Cycle</b>										
t <sub>RC</sub>	Read Cycle Time	15	—	20/25	—	35/45	—	55/70	—	ns
t <sub>AA</sub>	Address Access Time	—	15	—	20/25	—	35/45	—	55/70	ns
t <sub>ACS</sub>	Chip Select Access Time	—	15	—	20/25	—	35/45	—	55/70	ns
t <sub>CLZ</sub> <sup>(2)</sup>	Chip Deselect to Output in Low-Z	3	—	5/5	—	5/5	—	5/5	—	ns
t <sub>CHZ</sub> <sup>(2)</sup>	Chip Select to Output in High-Z	—	10	—	10/10	—	15/30	—	40/40	ns
t <sub>OH</sub>	Output Hold from Address Change	3	—	5/5	—	5/5	—	5/5	—	ns
t <sub>PU</sub> <sup>(2)</sup>	Chip Select to Power-Up Time	0	—	0/0	—	0/0	—	0/0	—	ns
t <sub>PD</sub> <sup>(2)</sup>	Chip Deselect to Power-Down Time	—	15	—	20/25	—	35/45	—	55/70	ns
<b>Write Cycle</b>										
t <sub>WC</sub>	Write Cycle Time	15	—	20/20	—	30/45	—	55/70	—	ns
t <sub>CW</sub>	Chip Select to End-of-Write	15	—	15/20	—	30/40	—	45/55	—	ns
t <sub>AW</sub>	Address Valid to End-of-Write	15	—	15/20	—	30/40	—	45/55	—	ns
t <sub>AS</sub>	Address Set-up Time	0	—	0/0	—	0/0	—	0/0	—	ns
t <sub>WP</sub>	Write Pulse Width	13	—	15/20	—	30/30	—	35/40	—	ns
t <sub>WR</sub>	Write Recovery Time	0	—	0/0	—	0/0	—	0/0	—	ns
t <sub>DW</sub>	Data Valid to End-of-Write	10	—	12/15	—	17/20	—	25/30	—	ns
t <sub>DH</sub>	Data Hold Time	0	—	0/0	—	0/0	—	0/0	—	ns
t <sub>WHZ</sub> <sup>(2)</sup>	Write Enable to Output in High-Z	—	7	—	8/8	—	15/30	—	40/40	ns
t <sub>OW</sub> <sup>(2)</sup>	Output Active from End-of-Write	0	—	0/0	—	0/0	—	0/0	—	ns

**NOTES:**

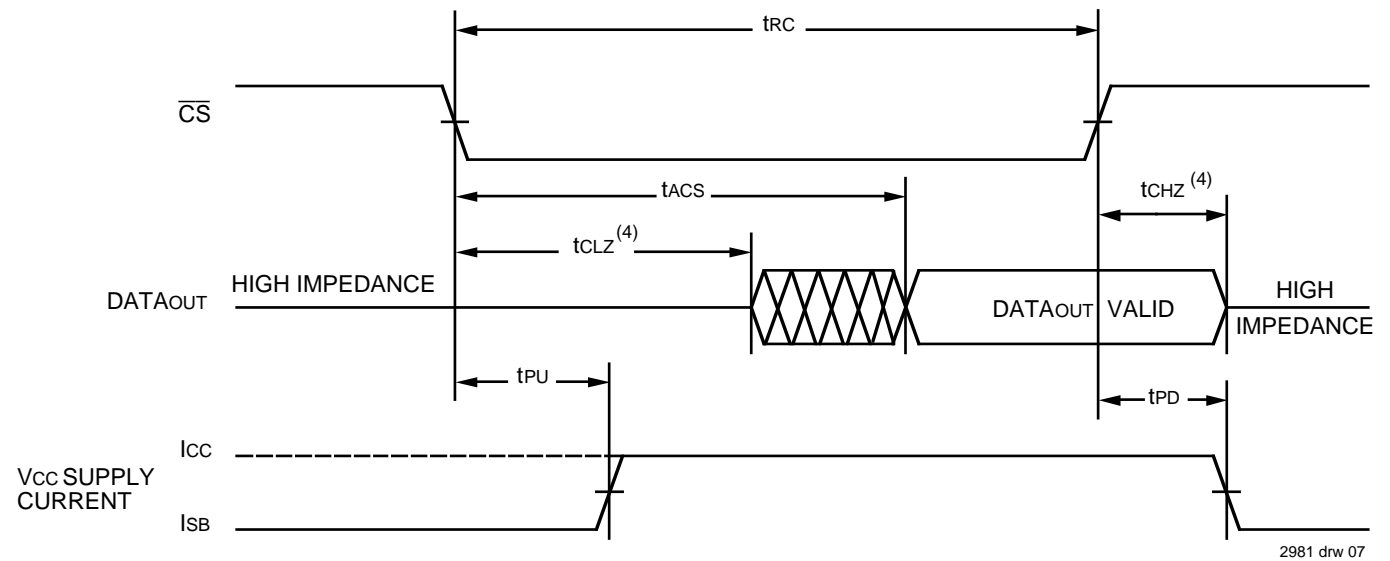
1. -55°C to +125°C temperature range only. Also available: 85ns and 100ns Military devices.
2. This parameter is guaranteed with AC Load (Figure 2) by device characterization, but is not production tested.

2981 tbl 11

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



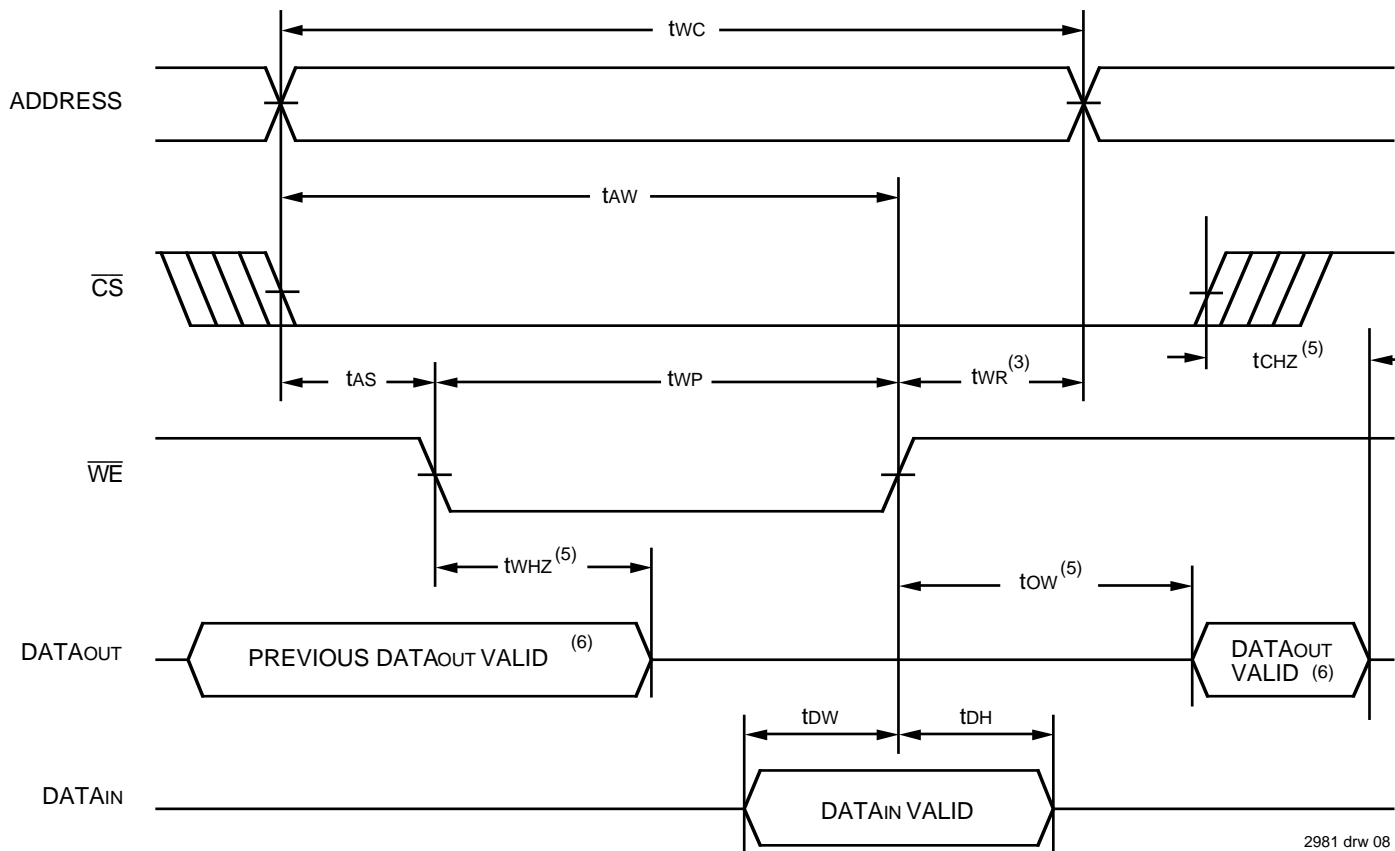
### TIMING WAVEFORM OF READ CYCLE NO. 2(1, 3)



**NOTES:**

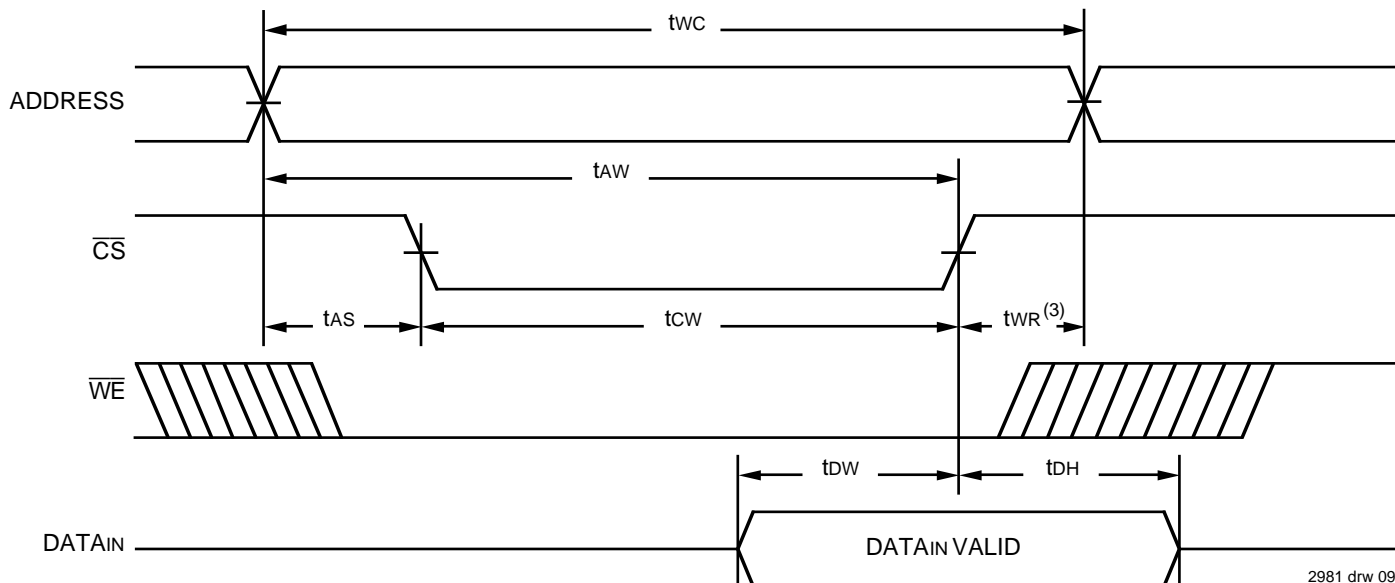
1.  $\overline{WE}$  is HIGH for Read cycle.
2. Device is continuously selected,  $\overline{CS}$  is LOW.
3. Address valid prior to or coincident with  $\overline{CS}$  transition LOW.
4. Transition is measured  $\pm 200\text{mV}$  from steady state.

**TIMING WAVEFORM OF WRITE CYCLE NO. 1, ( $\overline{WE}$  CONTROLLED TIMING)<sup>(1, 2, 4)</sup>**



2981 drw 08

**TIMING WAVEFORM OF WRITE CYCLE NO. 2, ( $\overline{CS}$  CONTROLLED TIMING)<sup>(1, 2, 4)</sup>**

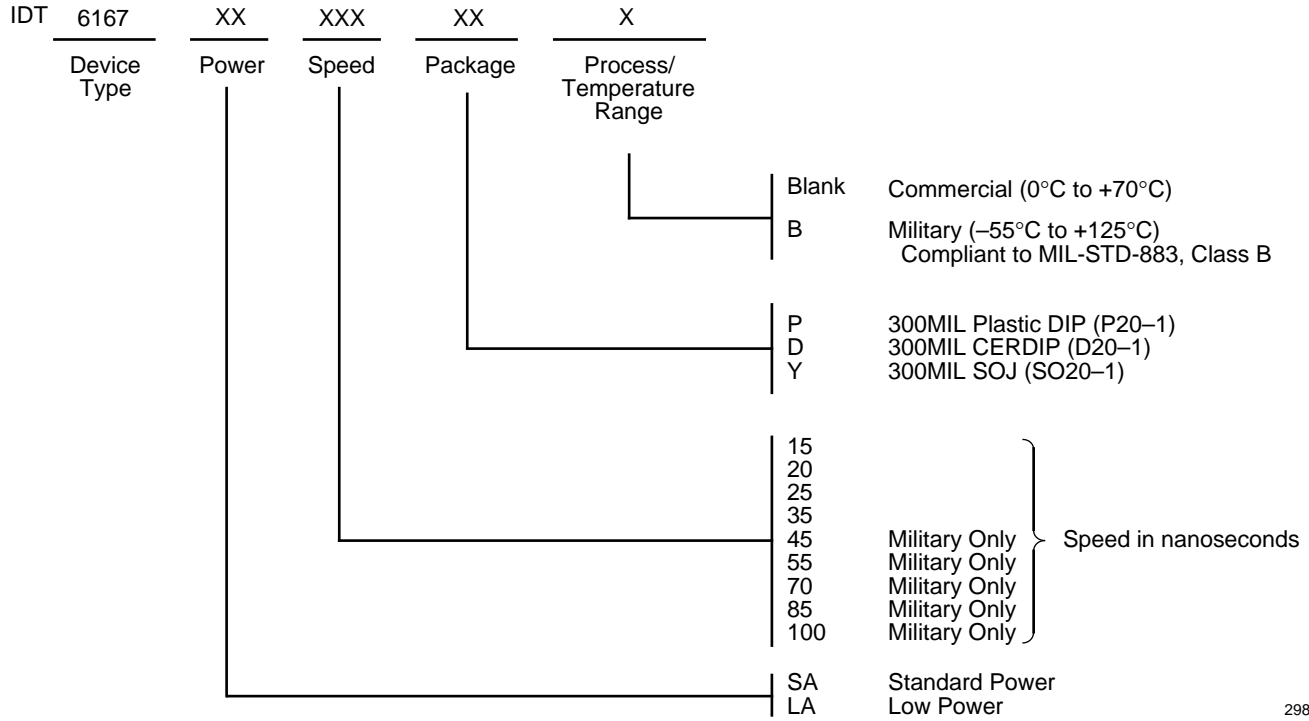


2981 drw 09

**NOTES:**

1.  $\overline{WE}$  or  $\overline{CS}$  must be inactive during all address transitions.
2. A write occurs during the overlap of a LOW  $\overline{CS}$  and a LOW  $\overline{WE}$ .
3.  $t_{WR}$  is measured from the earlier of  $\overline{CS}$  or  $\overline{WE}$  going HIGH to the end of the write cycle.
4. If the  $\overline{CS}$  low transition occurs simultaneously with or after the  $\overline{WE}$  LOW transition, the outputs remain in the high-impedance state.
5. Transition is measured  $\pm 200\text{mV}$  from steady state.
6. During this period, the I/O pins are in the output state and the input signals must not be applied.

**ORDERING INFORMATION**



2981 drw 10