



Integrated Device Technology, Inc.

BiCMOS StaticRAM 240K (16K x 15-BIT) CACHE-TAG RAM For PowerPC™ and RISC Processors

IDT71216

FEATURES:

- 16K x 15 Configuration
 - 12 TAG Bits
 - 3 Separate I/O Status Bits (Valid, Dirty, Write Through)
- Match output uses Valid bit to qualify MATCH output
- High-Speed Address-to-Match comparison times
 - 8/9/10/12ns over commercial temperature range
- TA circuitry included inside the Cache-Tag for highest speed operation
- Asynchronous Read/Match operation with Synchronous Write and Reset operation
- Separate $\overline{WE}$ for the TAG bits and the Status bits
- Separate $\overline{OE}$ for the TAG bits, the Status bits, and TA
- Synchronous $\overline{RESET}$ pin for invalidation of all Tag entries
- Dual Chip selects for easy depth expansion with no performance degradation
- I/O pins both 5V TTL and 3.3V LVTTTL compatible with Vccq pins
- $\overline{PWRDN}$ pin to place device in low-power mode
- Packaged in a 80-pin Thin Plastic Quad Flat Pack (TQFP)

DESCRIPTION:

The IDT71216 is a 245,760-bit Cache Tag StaticRAM, organized 16K x 15 and designed to support PowerPC and other RISC processors at bus speeds up to 66MHz. There are twelve common I/O TAG bits, with the remaining three bits used as status bits. A 12-bit comparator is on-chip to allow fast comparison of the twelve stored TAG bits and the current Tag input data. An active HIGH MATCH output is generated when these two groups of data are the same for a given address.

This high-speed MATCH signal, with tADM as fast as 8ns, provides the fastest possible enabling of secondary cache accesses.

The three separate I/O status bits (VLD, DTY, and WT) can be configured for either dedicated or generic functionality, depending on the SFUNC input pin. With SFUNC LOW, the status bits are defined and used internally by the device, allowing easier determination of the validity and use of the given Tag data. SFUNC HIGH releases the defined internal status bit usage and control, allowing the user to configure the status bit information to fit his system needs. A synchronous $\overline{RESET}$ pin, when held LOW at a rising clock edge, will reset all status bits in the array for easy invalidation of all Tag addresses.

The IDT71216 also provides the option for Transfer Acknowledge (TA) generation within the cache tag itself, based upon MATCH, VLD bit, WT bit, and external inputs provided by the user. This can significantly simplify cache controller logic and minimize cache decision time. Match and Read operations are both asynchronous in order to provide the fastest access times possible, while Write operations are synchronous for ease of system timing.

The IDT71216 uses a 5V power supply on Vcc, with separate Vccq pins provided for the outputs to offer compliance with both 5.0V TTL and 3.3V LVTTTL Logic levels. The $\overline{PWRDN}$ pin offers a low-power standby mode to reduce power consumption by 90%, providing significant system power savings.

The IDT71216 is fabricated using IDT's high-performance, high-reliability BiCMOS technology and is offered in a space-saving 80-pin Thin Plastic Quad Flat Pack (TQFP) package.

PIN DESCRIPTIONS

A0 – A13	Address Inputs	Input
$\overline{CS1}$, CS2	Chip Selects	Input
$\overline{WET}$	Write Enable - Tag Bits	Input
$\overline{WES}$	Write Enable - Status Bits	Input
$\overline{OET}$	Output Enable - Tag Bits	Input
$\overline{OES}$	Output Enable - Status Bits	Input
$\overline{RESET}$	Status Bit Reset	Input
$\overline{PWRDN}$	Powerdown Mode Control Pin	Input
SFUNC	Status Bit Function Control Pin	Input
TT1	Read/Write Input from Processor	Input
VLDIN / S1IN	Valid Bit / S1 Bit Input	Input
DTYIN / S2IN	Dirty Bit / S2 Bit Input	Input
WTIN / S3IN	Write Through Bit / S3 Bit Input	Input

CLK	System Clock	Input
TAH	$\overline{TA}$ Force High	Input
$\overline{TAOE}$	$\overline{TA}$ Output Enable	Input
$\overline{TAIN}$	Additional $\overline{TA}$ Input	Input
$\overline{TA}$	Transfer Acknowledge	Output
TAG0 – TAG11	Tag Data Input/Outputs	I/O
VLDOUT / S1OUT	Valid Bit / S1 Bit Output	Output
DTYOUT / S2OUT	Dirty Bit / S2 Bit Output	Output
WTOUT / S3OUT	Write Through Bit / S3 Bit Output	Output
MATCH	Match	Output
VCC	+5V Power	Pwr
VCCQ	Output Buffer Power	QPwr
VSS	Ground	Gnd

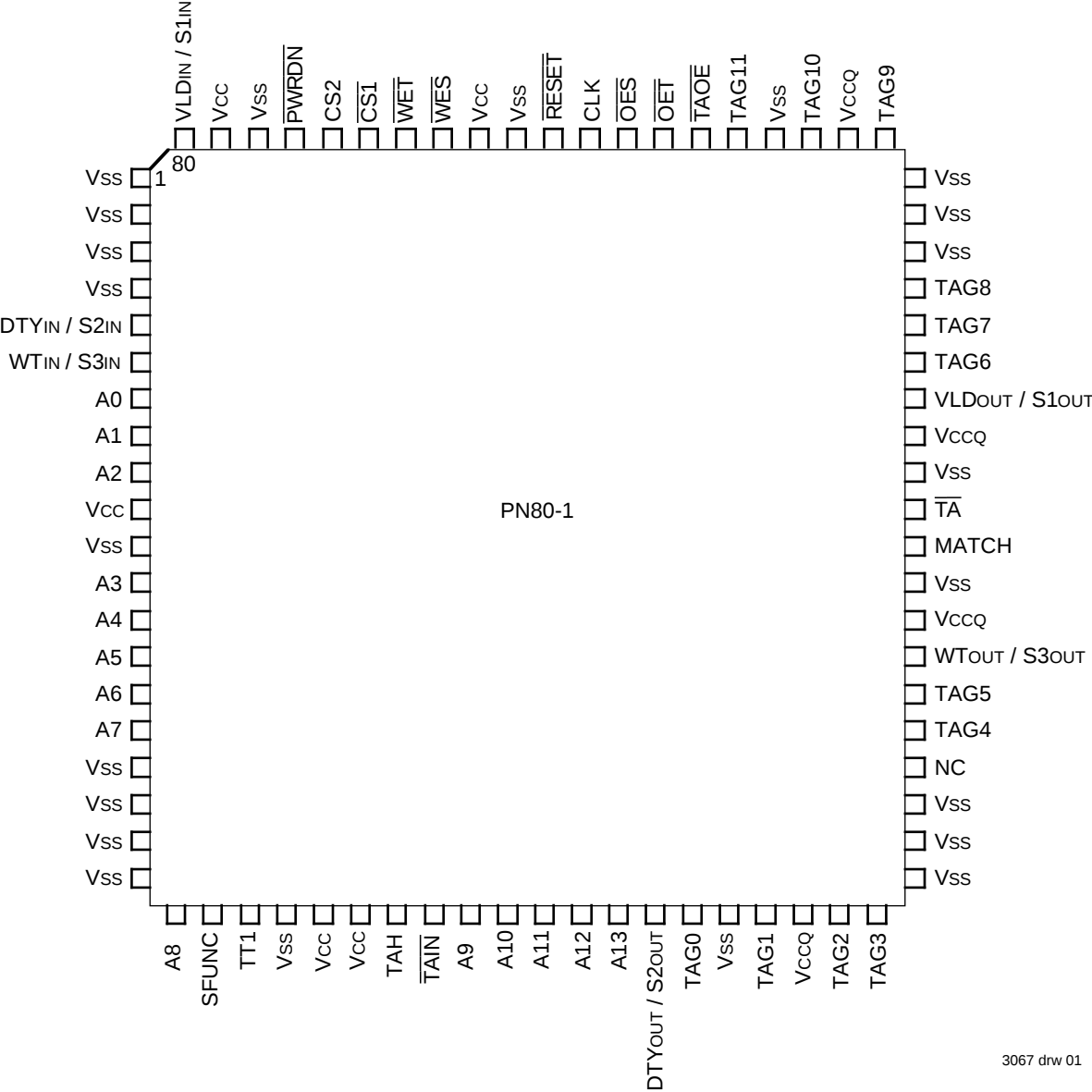
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3067 tbl 01

COMMERCIAL TEMPERATURE RANGE

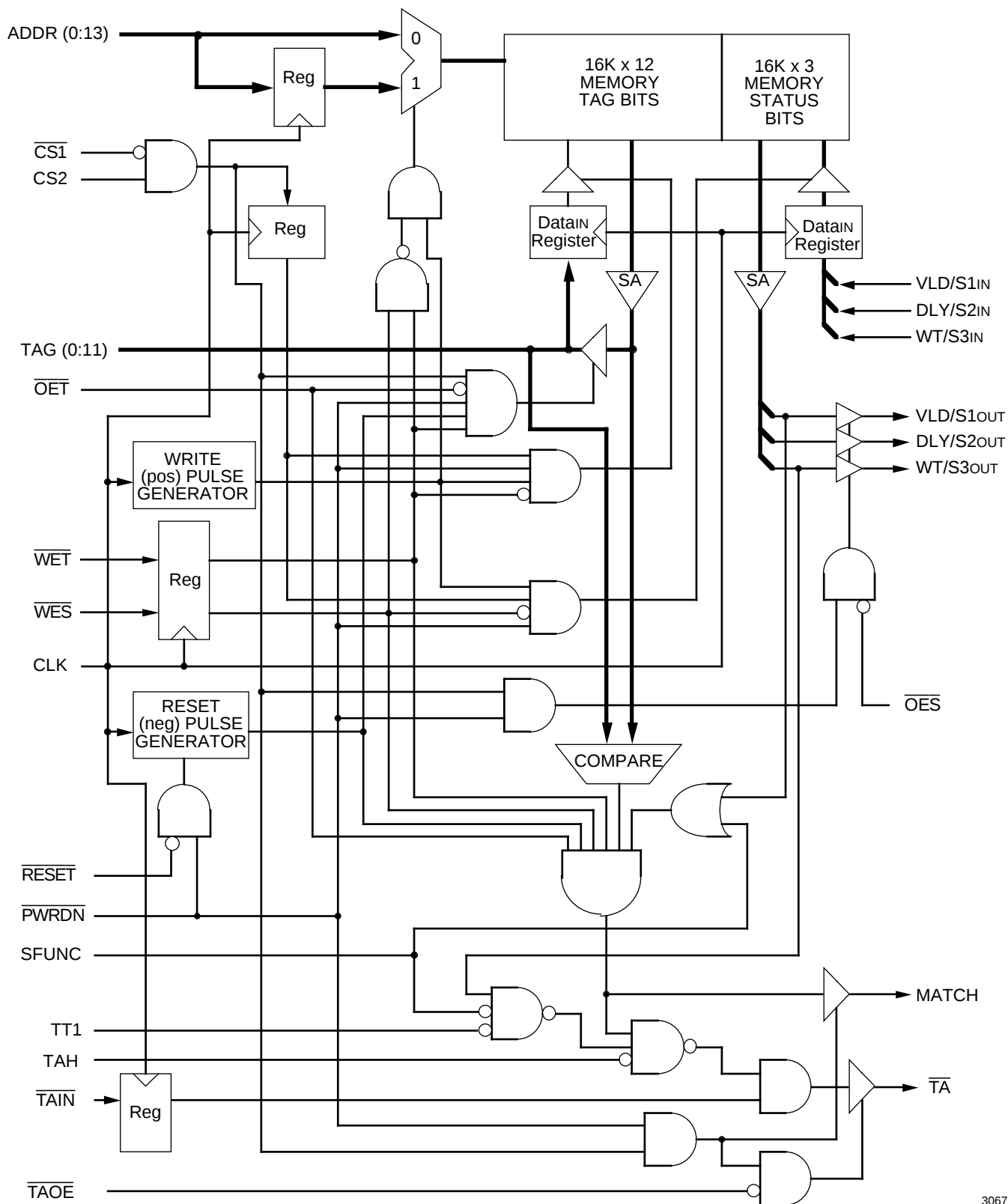
AUGUST 1996

PIN CONFIGURATION



TQFP
TOP VIEW

FUNCTIONAL BLOCK DIAGRAM



3067 drw 02

TRUTH TABLES

CHIP SELECT, RESET, AND POWER-DOWN FUNCTIONS^(1, 2)

CS1	CS2	RESET	PWRDN	CLK	WET	WES	TAOE	TAG	VLDout	DTYout	WTout	MATCH	TA	OPERATION	POWER
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CHIP SELECT FUNCTION

H	X	X	H	X	X	X	X	Hi-Z	Hi-Z	Hi-Z	Hi-Z	Hi-Z	Hi-Z	Deselected	Active
X	L	X	H	X	X	X	X	Hi-Z	Hi-Z	Hi-Z	Hi-Z	Hi-Z	Hi-Z	Deselected	Active
L	H	X	H	X	X	X	X	–	–	–	–	–	–	Selected	Active

RESET FUNCTION

L	H	L	H	↑	H	H	L	Hi-Z	L ⁽³⁾	L ⁽³⁾	L ⁽³⁾	L ⁽³⁾	H	Reset Status	Active
L	H	L	H	↑	H	H	H	Hi-Z	L ⁽³⁾	L ⁽³⁾	L ⁽³⁾	L ⁽³⁾	Hi-Z	Reset Status	Active
H	X	L	H	↑	H	H	X	Hi-Z	Hi-Z	Hi-Z	Hi-Z	Hi-Z	Hi-Z	Reset Status	Active
X	L	L	H	↑	H	H	X	Hi-Z	Hi-Z	Hi-Z	Hi-Z	Hi-Z	Hi-Z	Reset Status	Active
X	X	L	H	↑	L	X	X	–	–	–	–	–	–	Not Allowed	–
X	X	L	H	↑	X	L	X	–	–	–	–	–	–	Not Allowed	–

POWER-DOWN FUNCTION

X	X	X	L	X	H	H	X	Hi-Z	Hi-Z	Hi-Z	Hi-Z	Hi-Z	Hi-Z	Power-down	Standby
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NOTES:

- "H" = V_{IH}, "L" = V_{IL}, "X" = don't care, "–" = unrelated.
- $\overline{OET}$, $\overline{OES}$, TT1, TAH, $\overline{TAIN}$ and SFUNC are "X" for this table.
- OES is LOW.

3067 tbl 02

READ AND WRITE FUNCTIONS^(1, 2)

$\overline{OET}$	$\overline{OES}$	WET	WES	CLK	TT1	TAG	VLDin	DTYin	WTin	VLDout	DTYout	WTout	MATCH	OPERATION
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READ FUNCTION

L	X	H	X	X	X	DOUT	–	–	–	–	–	–	DOUT	Read TAG I/O
X	L	X	X	X	X	–	–	–	–	DOUT	DOUT	DOUT	DOUT	Read Status Bits
H	X	X	X	X	X	Hi-Z	–	–	–	–	–	–	DOUT	TAG I/O Disable
X	H	X	X	X	X	–	–	–	–	Hi-Z	Hi-Z	Hi-Z	DOUT	Status Disabled

WRITE FUNCTION

H	X	L	X	↑	X	DIN	–	–	–	DOUT	DOUT	DOUT	L	Write TAG I/O
L	X	L	X	↑	X	–	–	–	–	–	–	–	–	Not Allowed
X	L	X	L	↑	X	–	DIN	DIN	DIN	DOUT ⁽³⁾	DOUT ⁽³⁾	DOUT ⁽³⁾	L	Write Status Bits
X	H	X	L	↑	X	–	DIN	DIN	DIN	Hi-Z	Hi-Z	Hi-Z	L	Write Status Bits

NOTES:

- "H" = V_{IH}, "L" = V_{IL}, "X" = don't care, "–" = unrelated.
- This table applies when CS1 is LOW and CS2, RESET, and PWRDN are HIGH. $\overline{TAOE}$, TAH, $\overline{TAIN}$ and SFUNC are "X" for this table.
- DOUT in this case is the same as DIN; that is, the input data is written through to the outputs during the write operation.

3067 tbl 03

TRUTH TABLES (CONT.)

MATCH FUNCTION^(1, 2, 3)

$\overline{CS1}$	CS2	SFUNC	$\overline{OET}$	$\overline{WET}$	$\overline{WES}$	TAG	VLD ⁽⁴⁾	DTY ⁽⁴⁾	WT ⁽⁴⁾	MATCH	OPERATION
H	X	X	X	X	X	Hi-Z	—	—	—	Hi-Z	Deselected
X	L	X	X	X	X	Hi-Z	—	—	—	Hi-Z	Deselected
L	H	X	X	X	X	—	—	—	—	DOUT	Selected
L	H	X	L	H	X	DOUT	—	—	—	L	Read Tag I/O
L	H	X	H	L	X	DIN	—	—	—	L	Write Tag I/O
L	H	X	X	X	L	—	DIN	DIN	DIN	L	Write Status Bits
L	H	L	H	H	H	TAGIN	L	—	—	L	Invalid Data - Dedicated Status Bits
L	H	L	H	H	H	TAGIN	H	—	—	M	Match - Dedicated Status Bits
L	H	H	H	H	H	TAGIN	X	—	—	M	Match - Generic Status Bits

NOTES:

3067 tbl 04

- "H" = V_{IH} , "L" = V_{IL} , "X" = don't care, "—" = unrelated.
- M = HIGH if TAGIN equals the memory contents at that address; M = LOW if TAGIN does not equal the memory contents at that address.
- PWRDN and RESET are HIGH for this table. TT1, TAH, TAOE, TAIN, OES, and CLK are "X".
- This column represents the stored memory cell data for the given Status bit at the selected address.

$\overline{TA}$ FUNCTION^(1, 2, 3, 5)

TAOE	$\overline{TAIN}^{(6)}$	$\overline{OET}$	$\overline{WET}$	$\overline{WES}$	TAH	TT1	SFUNC	VLD ⁽⁴⁾	DTY ⁽⁴⁾	WT ⁽⁴⁾	TAG	MATCH	$\overline{TA}$	OPERATION
H	X	X	X	X	X	X	X	X	—	X	—	—	Hi-Z	$\overline{TA}$ Disabled
L	L	X	X	X	X	X	X	X	—	X	—	X	L	External $\overline{TA}$ Input ⁽⁷⁾
L	H	L	X	X	X	X	X	X	—	X	DOUT	L	H	Read TAG
L	H	X	L	X	X	X	X	X	—	X	DIN	L	H	Write TAG
L	H	X	X	L	X	X	X	DIN	DIN	DIN	—	L	H	Write Status
L	H	X	X	X	H	X	X	X	—	X	—	X	H	Force $\overline{TA}$ HIGH
L	H	X	X	X	X	X	L	L	—	X	—	L	H	Invalid TAG
L	H	X	X	X	X	L	L	X	—	H	—	X	H	Write Through
L	H	H	H	H	L	X	L	H	—	L	TAGIN	M	$\overline{M}$	Compare
L	H	H	H	H	L	H	L	H	—	X	TAGIN	M	$\overline{M}$	Compare
L	H	H	H	H	L	X	L	H	—	X	TAGIN	M	$\overline{M}$	Compare
L	H	H	H	H	L	X	H	X	—	X	TAGIN	M	$\overline{M}$	Compare

NOTES:

3067 tbl 05

- "H" = V_{IH} , "L" = V_{IL} , "X" = don't care, "—" = unrelated.
- M = HIGH if TAGIN equals the memory contents at that address; M = LOW if TAGIN does not equal the memory contents at that address.
- PWRDN and RESET are HIGH for this table. CLK and OES are "X".
- This column represents the stored memory cell data for the given Status bit at the selected address.
- $\overline{CS1}$ is LOW, CS2 is HIGH for this table.
- $\overline{TAIN}$ is a synchronous input; thus the inputs noted in the table must be applied during a rising CLK edge.
- $\overline{TAIN}$ will be a factor in determining the $\overline{TA}$ output in all cases except when TAH is HIGH and there is a valid MATCH. In that case, $\overline{TA}$ will be LOW(Valid).

RECOMMENDED DC OPERATING CONDITIONS

Symbol	Parameter	Min.	Typ.	Max.	Unit
V _{CC}	Supply Voltage	4.75	5.0	5.25	V
V _{CCQ}	5V Output Buffers	4.75	5.0	5.25	V
V _{CCQ}	3.3V Output Buffers	3.0	3.3	3.6	V
V _{SS}	Supply Ground	0	0	0	V
V _{IH}	Input High Voltage	2.2	3.0	V _{CC} +0.3	V
V _{IHQ}	I/O High Voltage	2.2	3.0	V _{CCQ} +0.3	V
V _{IL}	Input Low Voltage	-0.5 ⁽¹⁾	—	0.8	V

NOTE: 3067 tbl 06
1. V_{IL} (min.) = -1.5V for pulse width of less than 10ns, once per cycle.

CAPACITANCE

(T_A = +25°C, f = 1.0 MHz)

Symbol	Parameter ⁽¹⁾	Condition	Max.	Unit
C _{IN}	Input Capacitance	V _{IN} = 0V	5	pF
C _{TAG}	TAG Input/Output Capacitance	V _{I/O} = 0V	7	pF
C _{OUT}	Output Capacitance	V _{OUT} = 0V	7	pF

NOTE: 3067 tbl 07
1. This parameter is determined by device characterization but is not production tested.

ABSOLUTE MAXIMUM RATINGS⁽¹⁾

Symbol	Rating	Value	Unit
V _{TERM}	Terminal Voltage with Respect to GND	-0.5 to +7.0 ⁽²⁾	V
T _A	Operating Temperature	-0 to +70	°C
T _{BIAS}	Temperature Under Bias	-65 to +135	°C
T _{STG}	Storage Temperature	-65 to +150	°C
P _T	Power Dissipation	1.7	W
I _{OUT}	DC Output Current	20	mA

NOTES: 3067 tbl 08
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_{IN} should not exceed V_{CC}+0.5V. All pins should not exceed 7.0V. V_{CCQ} should never exceed V_{CC}, and V_{CC} should never exceed V_{CCQ} + 4.0V.

DC ELECTRICAL CHARACTERISTICS OVER THE OPERATING TEMPERATURE AND SUPPLY VOLTAGE RANGE

(V_{CC} = 5.0V ± 5%, V_{CCQ} = 5.0V ± 5% OR 3.3V ± 0.3V)

Symbol	Parameter	Test Condition	Min.	Max.	Unit
I _{LI}	Input Leakage Current	V _{CC} = Max., V _{IN} = 0V to V _{CC}	—	5	μA
I _{LO}	Output Leakage Current	$\overline{CS1} \geq V_{IH}$, CS2 ≤ V _{IL} , $\overline{OE} \geq V_{IH}$, V _{CC} = Max. V _{OUT} = 0V to V _{CCQ} , V _{CCQ} = Max.	—	5	μA
V _{OL}	Output Low Voltage	I _{OL} = 4mA, V _{CC} = Min.	—	0.4	V
V _{OH}	Output High Voltage	I _{OH} = -4mA, V _{CC} = Min.	2.4	—	V

3067 tbl 09

DC ELECTRICAL CHARACTERISTICS OVER THE OPERATING TEMPERATURE AND SUPPLY VOLTAGE RANGE^(1, 2) (V_{CC} = 5.0V ± 5%)

Symbol	Parameter	Test Condition	71216S8		71216S9		71216S10		71216S12		Unit
			Com'l.	Mil.	Com'l.	Mil.	Com'l.	Mil.	Com'l.	Mil.	
I _{CC}	Operating Power Supply Current	$\overline{PWRDN} \geq V_{IH}$ Outputs Open, V _{CC} = Max., f = f _{MAX} ⁽³⁾	330	—	300	—	290	—	280	—	mA
I _{SB}	Standby Power Supply Current	$\overline{PWRDN} \leq V_{IL}$, V _{IN} ≥ V _{IH} or ≤ V _{IL} V _{CC} = Max., f = f _{MAX} ⁽³⁾	30	—	30	—	30	—	30	—	mA
I _{SB1}	Full Standby Power Supply Current	$\overline{PWRDN} \leq V_{IL}$, V _{IN} ≥ V _{HC} or ≤ V _{LC} ⁽⁴⁾ V _{CC} = Max., f = 0 ⁽³⁾	25	—	25	—	25	—	25	—	mA

NOTES: 3067 tbl 10
1. All values are maximum guaranteed values.
2. $\overline{CS1} \leq V_{IL}$, CS2 ≥ V_{IH}.
3. f_{MAX} = 1/t_{CYC} (all address inputs are cycling at f_{MAX}). f = 0 means no address input lines are changing.
4. V_{HC} = V_{CC} - 0.2V, V_{LC} = 0.2V

AC ELECTRICAL CHARACTERISTICS

(V_{CC} = 5.0V ± 5%, V_{CCQ} = 5.0V ± 5% OR 3.3V ± 0.3V, T_A = 0 to 70°C)

Symbol	Parameter	IDT71216S8		IDT71216S9		IDT71216S10		IDT71216S12		Unit
		Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	
Read Cycle										
tAAT	Address Access Time Tag Bits	—	10	—	11	—	12	—	14	ns
tACST	Chip Select Access Time Tag Bits	—	8	—	9	—	10	—	12	ns
tCLZ ⁽¹⁾	Chip Select to Tag and Status Bits in Low-Z	1	—	1	—	1	—	1	—	ns
tCHZ ⁽¹⁾	Chip Select to Tag and Status Bits in High-Z	1	5	1	6	1	6	1	7	ns
tOET	Output Enable to Tag Bits Valid	—	5	—	6	—	6	—	7	ns
tOTLZ ⁽¹⁾	Output Enable to Tag Bits in Low-Z	0	—	0	—	0	—	0	—	ns
tOTHZ ⁽¹⁾	Output Enable to Tag Bits in High-Z	1	5	1	6	1	6	1	7	ns
tTOH	Tag Bit Hold from Address Change	2	—	2	—	2	—	2	—	ns
tOES	Output Enable to Status Bits Valid	—	5	—	6	—	6	—	7	ns
tOSLZ ⁽¹⁾	Output Enable to Status Bits in Low-Z	0	—	0	—	0	—	0	—	ns
tOSHZ ⁽¹⁾	Output Enable to Status Bits in High-Z	1	5	1	6	1	6	1	7	ns
tAAS	Address Access Time Status Bits	—	8	—	9	—	10	—	12	ns
tACSS	Chip Select Access Time Status Bits	—	6	—	7	—	8	—	10	ns
tSOH	Status Bit Hold from Address Change	2	—	2	—	2	—	2	—	ns

NOTE:

3067 tbl 11

1. This parameter is guaranteed with the AC Load (Figure 3) by device characterization, but is not production tested.

AC ELECTRICAL CHARACTERISTICS ⁽¹⁾

(V_{CC} = 5.0V ± 5%, V_{CCQ} = 5.0V ± 5% OR 3.3V ± 0.3V, T_A = 0 to 70°C)

Symbol	Parameter	IDT71216S8		IDT71216S9		IDT71216S10		IDT71216S12		Unit
		Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	
Reset and Power Down Cycles										
tSR	$\overline{\text{RESET}}$ Set-up Time	4	—	4	—	4	—	4	—	ns
tHR	$\overline{\text{RESET}}$ Hold Time	1	—	1	—	1	—	1	—	ns
tSRST	Status Bit Reset Time	—	50	—	60	—	60	—	70	ns
tSHRS	Status Bit Hold from $\overline{\text{RESET}}$ LOW	2	—	2	—	2	—	2	—	ns
tRSMI	$\overline{\text{RESET}}$ LOW to MATCH and $\overline{\text{TA}}$ Invalid	—	9	—	10	—	10	—	12	ns
tRSMV	$\overline{\text{RESET}}$ HIGH to MATCH and $\overline{\text{TA}}$ Valid	—	110	—	120	—	120	—	130	ns
tRSZH ⁽²⁾	$\overline{\text{RESET}}$ LOW to TAG High-Z	—	9	—	10	—	10	—	12	ns
tRSLZ ⁽²⁾	$\overline{\text{RESET}}$ HIGH to TAG Low-Z	—	90	—	100	—	100	—	110	ns
tPDSR	$\overline{\text{PWRDN}}$ Set-up to $\overline{\text{RESET}}$ LOW	30	—	30	—	30	—	30	—	ns
tRHPL	$\overline{\text{RESET}}$ HIGH to $\overline{\text{PWRDN}}$ LOW	1	—	1	—	1	—	1	—	CLK
tRHWL	$\overline{\text{RESET}}$ HIGH to $\overline{\text{WET}}$ and $\overline{\text{WES}}$ LOW	90	—	95	—	95	—	105	—	ns
tPD ⁽²⁾	$\overline{\text{PWRDN}}$ LOW to Low Power Mode	—	50	—	50	—	50	—	50	ns
tPU ⁽²⁾	$\overline{\text{PWRDN}}$ HIGH to Active Power Mode	0	—	0	—	0	—	0	—	ns
tPDHZ ⁽²⁾	$\overline{\text{PWRDN}}$ LOW to Outputs in High-Z	—	9	—	10	—	10	—	12	ns
tPDLZ ⁽²⁾	$\overline{\text{PWRDN}}$ HIGH to Outputs in Low-Z	0	—	0	—	0	—	0	—	ns
tPUV	$\overline{\text{PWRDN}}$ HIGH to Outputs Valid	—	50	—	50	—	50	—	50	ns
tWHPL ⁽²⁾	$\overline{\text{WET}}$ and $\overline{\text{WES}}$ HIGH to $\overline{\text{PWRDN}}$ LOW	5	—	5	—	5	—	5	—	ns
tPUWL	$\overline{\text{PWRDN}}$ HIGH to $\overline{\text{WET}}$ and $\overline{\text{WES}}$ Active	50	—	50	—	50	—	50	—	ns

NOTES:

3067 tbl 12

1. Power-down mode is intended to be used during extended time periods of device inactivity.
2. This parameter is guaranteed with the AC Load (Figure 3) by device characterization, but is not production tested.

AC ELECTRICAL CHARACTERISTICS ⁽¹⁾

(V_{CC} = 5.0V ± 5%, V_{CCQ} = 5.0V ± 5% OR 3.3V ± 0.3V, T_A = 0 to 70°C)

Symbol	Parameter	IDT71216S8		IDT71216S9		IDT71216S10		IDT71216S12		Unit
		Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	
Write Cycle and Clock Parameters										
tCYC	Clock Cycle Time	15	—	15	—	15	—	16.6	—	ns
tCH ^(2, 3)	Clock Pulse HIGH	4.5	—	4.5	—	4.5	—	5	—	ns
tCL ^(2, 3)	Clock Pulse LOW	4.5	—	4.5	—	4.5	—	5	—	ns
tS	$\overline{WET}$, $\overline{WES}$, Chip Select, and Input Data Set-up Time	3	—	3	—	3	—	3	—	ns
tH	$\overline{WET}$, $\overline{WES}$, Chip Select, and Input Data Hold Time	1	—	1	—	1	—	1	—	ns
tSA	Address Set-up Time	3	—	3	—	3	—	3	—	ns
tHA	Address Hold Time	1	—	1	—	1	—	1	—	ns
tWMI	CLK HIGH Write to MATCH and $\overline{TA}$ Invalid	—	6	—	7	—	7	—	8	ns
tCKLZ ⁽³⁾	CLK HIGH Read to Outputs in Low-Z	1.5	—	1.5	—	1.5	—	1.5	—	ns
tCTV ⁽⁴⁾	CLK HIGH Read to Tag Bits Valid	—	9	—	10	—	10	—	12	ns
tCSV ⁽⁴⁾	CLK HIGH Write to Status Outputs Valid	—	8	—	9	—	9	—	10	ns
tCSH ⁽³⁾	Status Output Hold from CLK HIGH Write	0	—	0	—	0	—	0	—	ns
tWHPL	$\overline{WET}$ and $\overline{WES}$ HIGH to $\overline{PWRDN}$ LOW	5	—	5	—	5	—	5	—	ns
tPUWL	$\overline{PWRDN}$ HIGH to $\overline{WET}$ and $\overline{WES}$ Active	50	—	50	—	50	—	50	—	ns

NOTES:

1. All Write cycles are synchronous and referenced from rising CLK.
2. This parameter is measured as a HIGH time above 2.0V and a LOW time below 0.8V.
3. This parameter is guaranteed with the AC Load (Figure 3) by device characterization, but is not production tested.
4. Addresses are stable prior to CLK transition HIGH.

3067 tbl 14

AC ELECTRICAL CHARACTERISTICS

(V_{CC} = 5.0V ± 5%, V_{CCQ} = 5.0V ± 5% OR 3.3V ± 0.3V, T_A = 0 to 70°C)

Symbol	Parameter	IDT71216S8		IDT71216S9		IDT71216S10		IDT71216S12		Unit
		Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	
MATCH and $\overline{\text{TA}}$ Cycles										
tADM	Address to MATCH Valid	—	8	—	9	—	10	—	12	ns
tDAM	Data Input to MATCH Valid	—	8	—	9	—	10	—	12	ns
tCSM	Chip Select to MATCH Valid	—	8	—	9	—	10	—	12	ns
tCMLZ ⁽¹⁾	Chip Select to MATCH in Low-Z	1	—	1	—	1	—	1	—	ns
tCMHZ ⁽¹⁾	Chip Select to MATCH in High-Z	1	5	1	6	1	6	1	7	ns
tMHA	MATCH Valid Hold from Address	2	—	2	—	2	—	2	—	ns
tMHD	MATCH Valid Hold from Data	2	—	2	—	2	—	2	—	ns
tBHA	$\overline{\text{TA}}$ Valid Hold from Address	2	—	2	—	2	—	2	—	ns
tBHD	$\overline{\text{TA}}$ Valid Hold from Data	2	—	2	—	2	—	2	—	ns
tADB	Address to $\overline{\text{TA}}$ Valid	—	9	—	10	—	11	—	13	ns
tDAB	Data Input to $\overline{\text{TA}}$ Valid	—	9	—	10	—	11	—	13	ns
tCSB	Chip Select LOW to $\overline{\text{TA}}$ Valid	—	9	—	10	—	11	—	13	ns
toEBV	$\overline{\text{TAOE}}$ LOW to $\overline{\text{TA}}$ Valid	—	6	—	6	—	7	—	8	ns
toBLZ ⁽¹⁾	$\overline{\text{TAOE}}$ LOW to $\overline{\text{TA}}$ in Low-Z	0	—	0	—	0	—	0	—	ns
toBHZ ⁽¹⁾	$\overline{\text{TAOE}}$ HIGH to $\overline{\text{TA}}$ in High-Z	1	5	1	6	1	6	1	7	ns
tBYFH	TAH HIGH to Force $\overline{\text{TA}}$ HIGH	—	5	—	5	—	5	—	6	ns
tBYHV	TAH LOW to $\overline{\text{TA}}$ Valid	—	5	—	5	—	5	—	6	ns
tsB	TAIN Set-up Time	4	—	4	—	4	—	4	—	ns
tHB	TAIN Hold Time	1.5	—	1.5	—	1.5	—	1.5	—	ns
tBIBL	CLK HIGH $\overline{\text{TAIN}}$ LOW to $\overline{\text{TA}}$ LOW	—	6	—	6	—	7	—	8	ns
tBIBV	CLK HIGH $\overline{\text{TAIN}}$ HIGH to $\overline{\text{TA}}$ Valid	—	6	—	6	—	7	—	8	ns
toEMI	$\overline{\text{OET}}$ LOW to MATCH and $\overline{\text{TA}}$ Invalid	—	6	—	7	—	7	—	8	ns
toEMV	$\overline{\text{OET}}$ HIGH to MATCH and $\overline{\text{TA}}$ Valid	—	7	—	8	—	8	—	10	ns
tWRBH ⁽²⁾	$\overline{\text{W/R}}$ HIGH to $\overline{\text{TA}}$ HIGH	—	6	—	7	—	7	—	8	ns
tWRBV ⁽²⁾	$\overline{\text{W/R}}$ LOW to $\overline{\text{TA}}$ Valid	—	6	—	7	—	7	—	8	ns
twMI	CLK HIGH Write to MATCH and $\overline{\text{TA}}$ Invalid	—	7	—	7	—	7	—	8	ns
twMV ⁽³⁾	CLK HIGH Read to MATCH and $\overline{\text{TA}}$ Valid	—	8	—	9	—	10	—	12	ns

NOTES:

3067 tbl 15

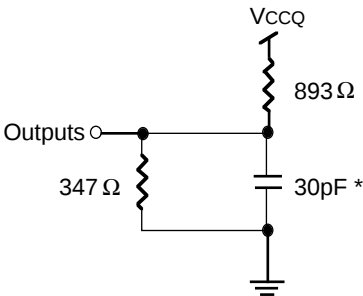
1. This parameter is guaranteed with the AC Load (Figure 3) by device characterization, but is not production tested.
2. These parameters only apply when SFUNC is LOW and the internal WT bit is HIGH.
3. t_{ADM}, t_{DAM}, t_{CSM} and t_{ADB}, t_{DAB}, t_{CSB} must also be satisfied.

AC TEST CONDITIONS

Input Pulse Levels	GND to 3.0V
Input Rise/Fall Times	3ns
Input Timing Reference Levels	1.5V
Output Timing Reference Levels	1.5V
AC Test Load	See Figs. 1, 2, 3, & 4

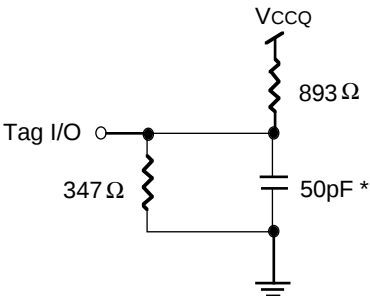
3067 tbl 16

AC TEST LOADS



3067 drw 03

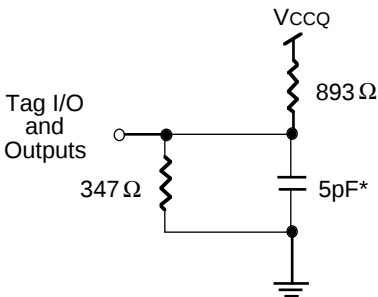
Figure 1. AC Test Load



3067 drw 04

Figure 2. Tag I/O AC Test Load

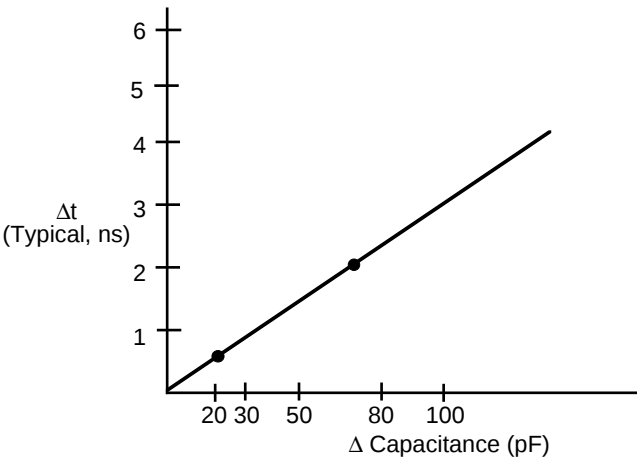
* Including scope and jig capacitance



3067 drw 05

Figure 3. AC Test Load
(for thz and tLZ parameters)

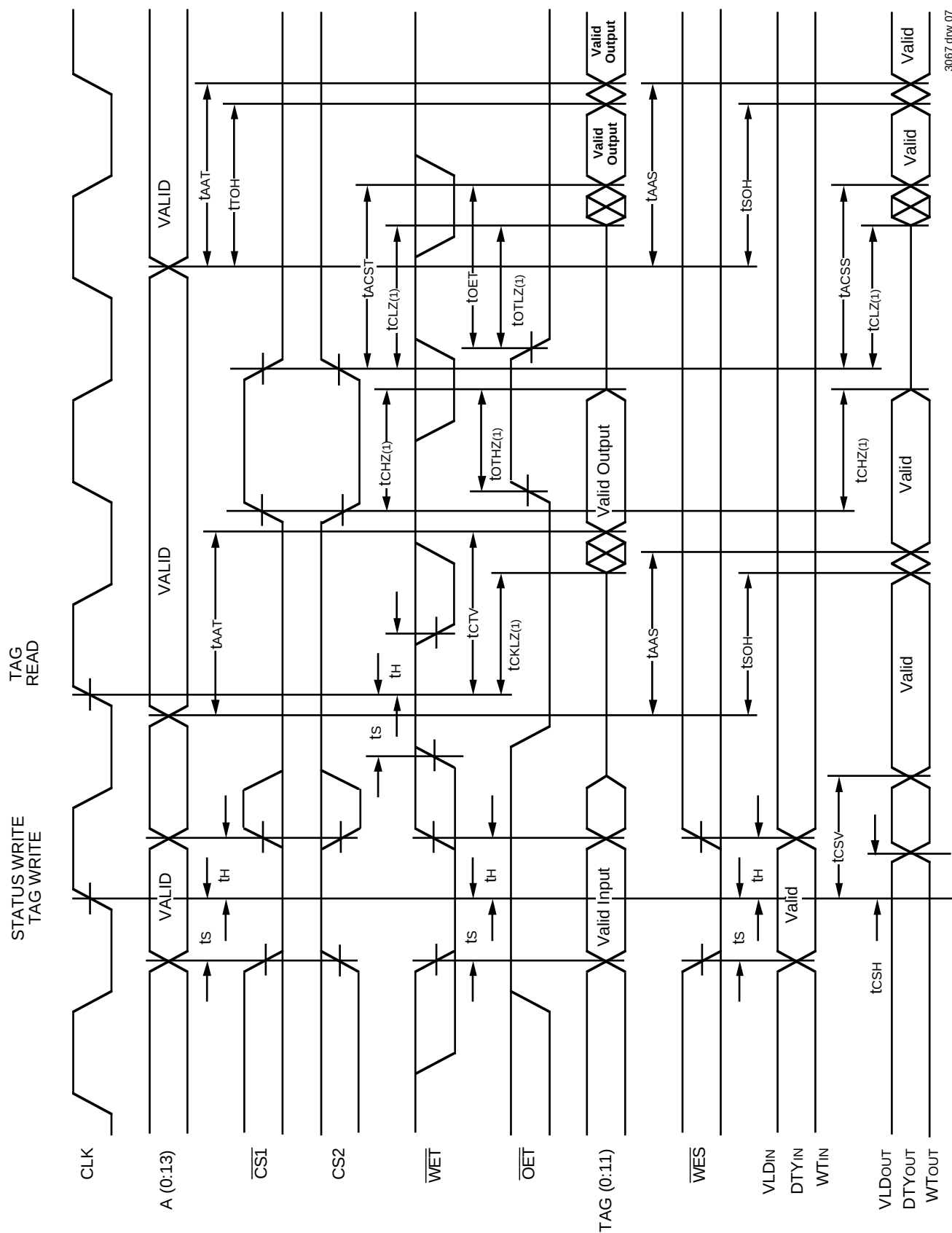
* Including scope and jig capacitance



3067 drw 06

Figure 4. Lumped Capacitance Load, Typical Derating

TIMING WAVEFORMS OF WRITE AND READ CYCLES



NOTE:

1. Transition is measured $\pm 200\text{mV}$ from steady state.

The diagram illustrates the timing characteristics of the 74VHC163 4-bit binary counter. It shows the relationship between the clock (CLK), address (A[0:13]), tag (TAG[0:11]), and various control signals (CS1, CS2, WES, WET, OET, TAH, TAOE, TA, MATCH) and their timing parameters.

Signals and Timing Parameters:

- CLK:** Clock signal.
- A (0:13):** Address bus. Timing parameters: t_{ADT} (Address Data Setup), t_{ADM} (Address Data Match), t_{MHA} (Match Hold Address), t_{THA} (Tag Hold Address).
- TAG (0:11):** Tag bus. Timing parameters: t_{DAT} (Data Address Tag), t_{DAM} (Data Address Match), t_{MHD} (Match Hold Data), t_{THD} (Tag Hold Data).
- CS1, CS2:** Chip Selects.
- WES, WET:** Write Enable Signals.
- OET:** Output Enable.
- TAH:** Tag Address Hold.
- TAOE:** Tag Address Output Enable.
- TA:** Tag Address.
- MATCH:** Match signal.

Timing Parameters:

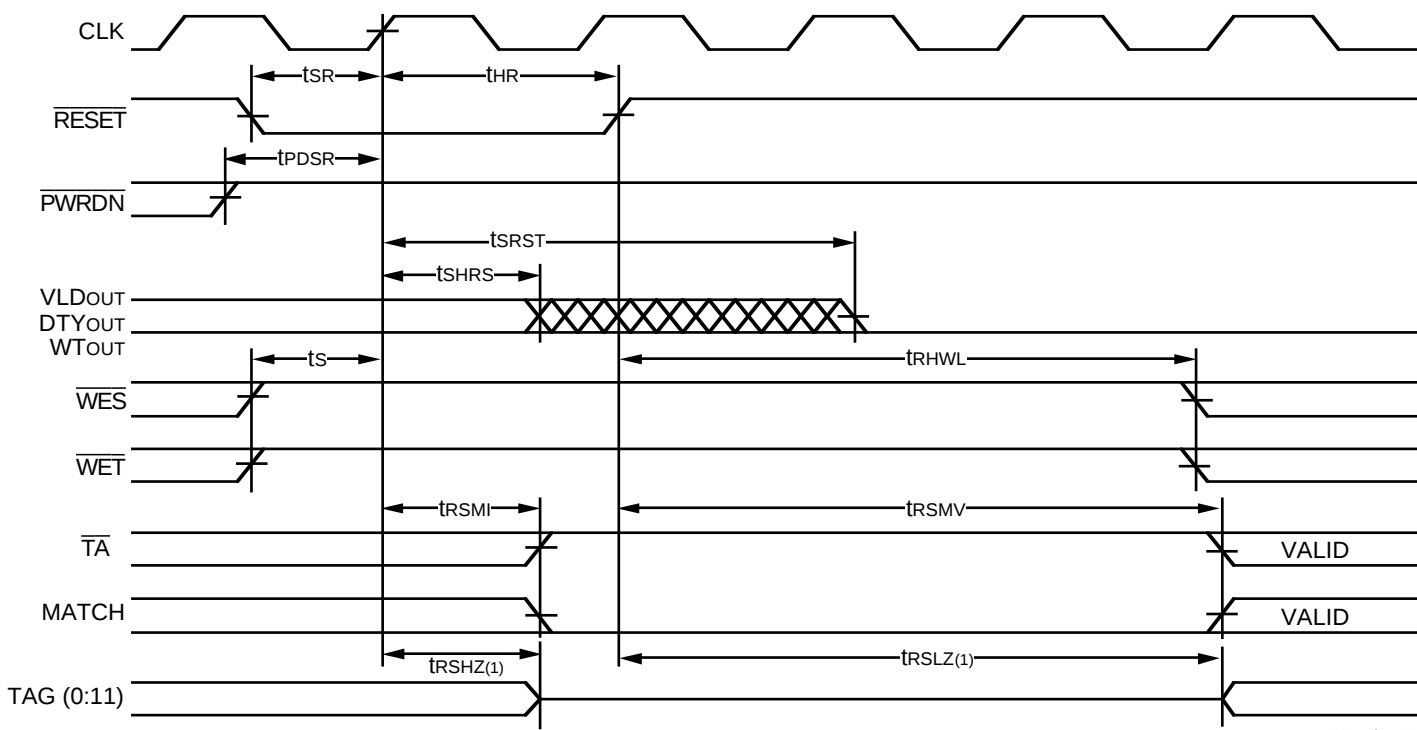
- t_{S} (Setup time)
- t_{H} (Hold time)
- t_{OETV} (Output Enable to Valid)
- $t_{OETZ(i)}$ (Output Enable to Zero)
- $t_{OETHZ(i)}$ (Output Enable to High-Z)
- $t_{OETMLZ(i)}$ (Output Enable to Multi-Drive Low-Z)
- t_{OETMV} (Output Enable to Multi-Drive Valid)
- t_{OETMI} (Output Enable to Multi-Drive Invalid)
- t_{TAHV} (Tag Address Hold to Valid)
- t_{TAFH} (Tag Address Hold to Invalid)
- t_{WMI} (Write Match Invalid)
- t_{WMV} (Write Match Valid)
- $t_{CMHZ(i)}$ (Clock to Multi-Drive High-Z)
- t_{CMV} (Clock to Multi-Drive Valid)
- t_{CMI} (Clock to Multi-Drive Invalid)

3067 drw 08

NOTE:

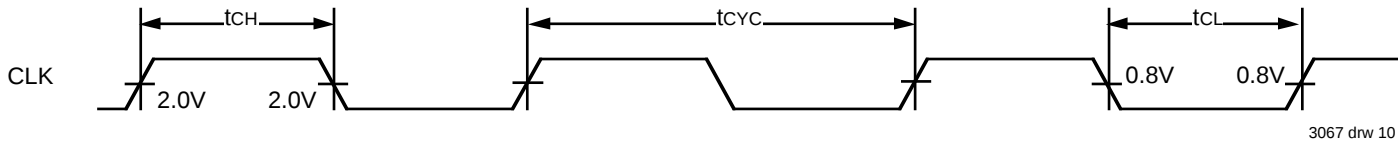
1. Transition is measured $\pm 200\text{mV}$ from steady state.

TIMING WAVEFORMS OF RESET FUNCTION



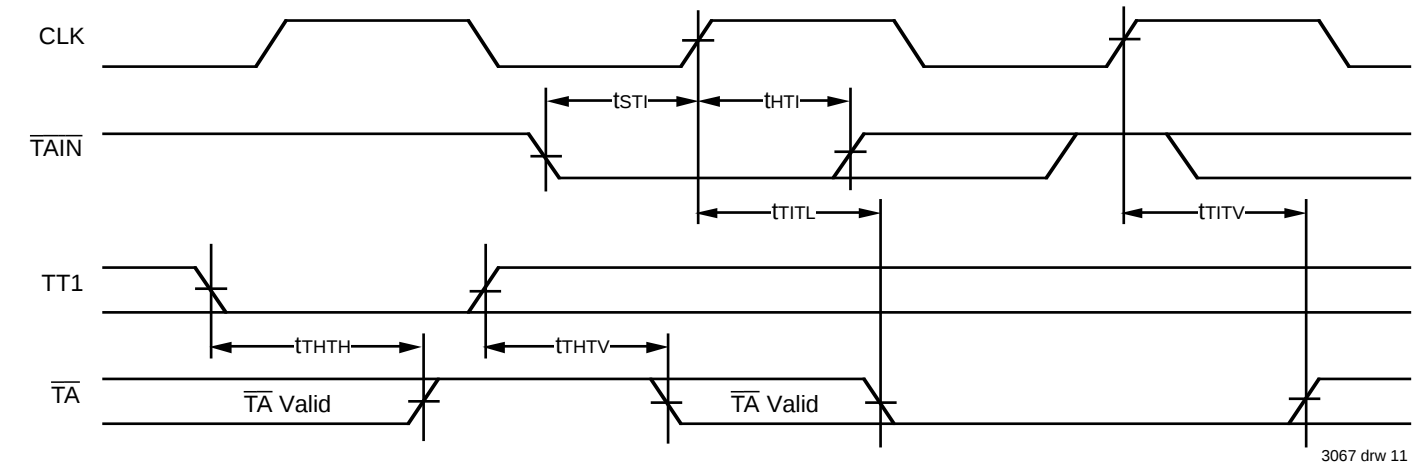
NOTE:
1. Transition is measured $\pm 200\text{mV}$ from steady state.

CLOCK TIMING WAVEFORM

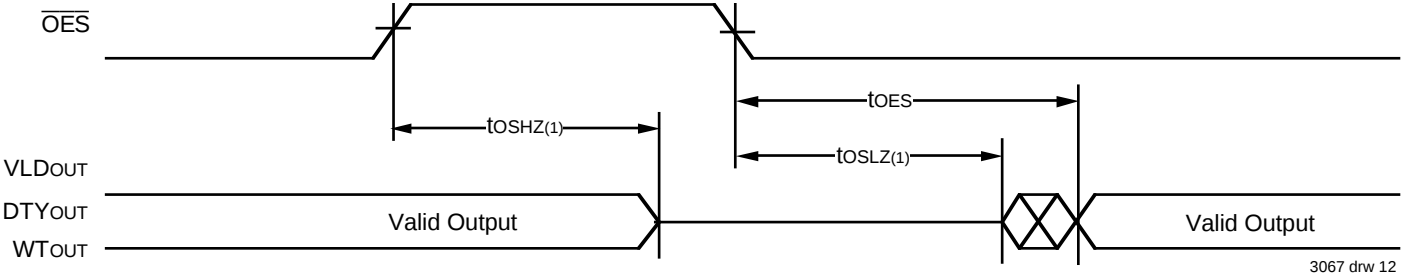


TIMING WAVEFORMS OF TA AND TT1 SIGNAL

Applies when SFUNC is LOW, and the internal WT bit is HIGH

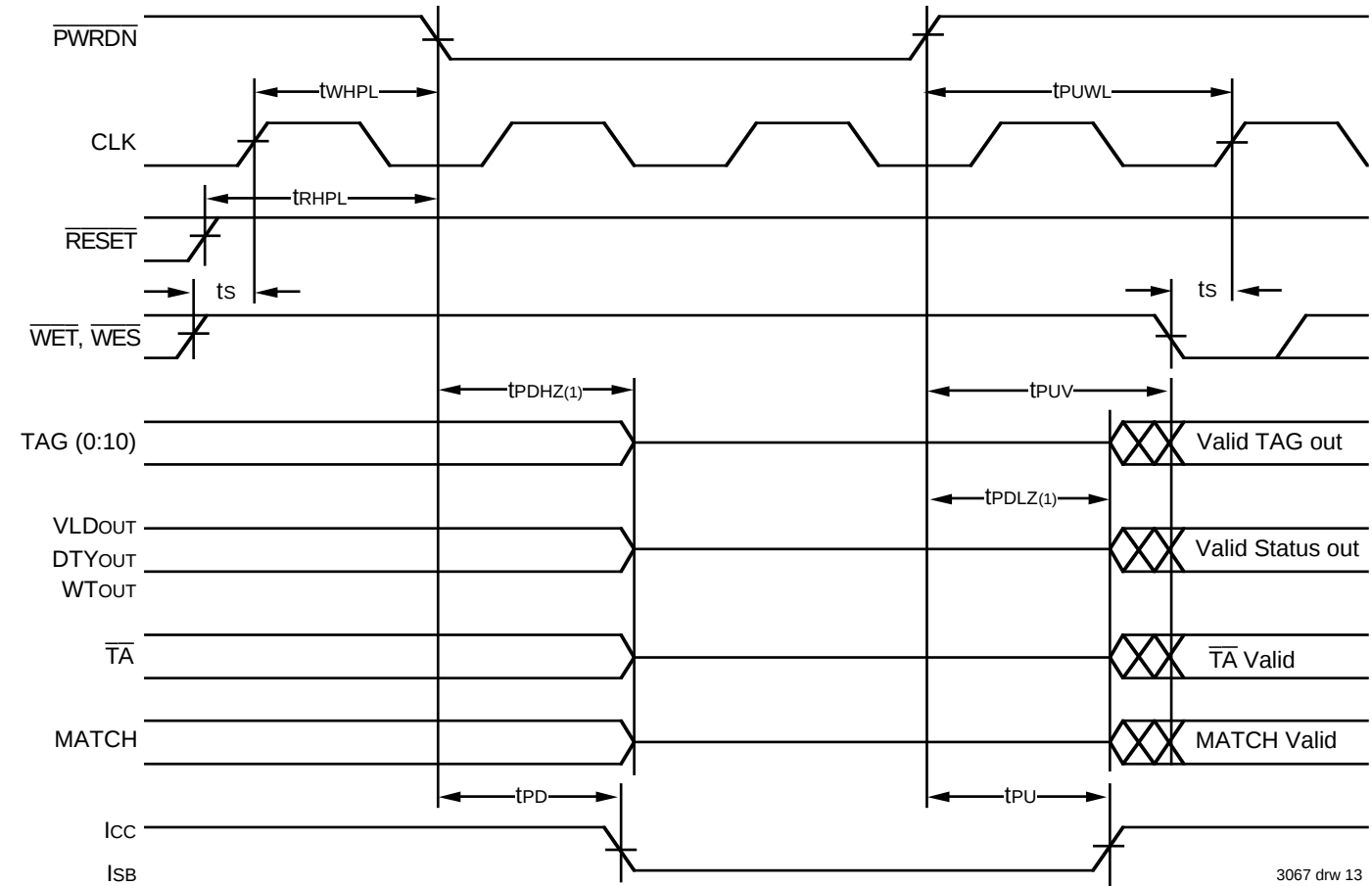


TIMING WAVEFORMS OF $\overline{\text{OES}}$ FUNCTION



NOTE:
1. Transition is measured $\pm 200\text{mV}$ from steady state.

TIMING WAVEFORMS OF POWER DOWN FUNCTION



NOTE:
1. Transition is measured $\pm 200\text{mV}$ from steady state.

ORDERING INFORMATION

IDT	71216	S	XX	PF	
Device Type	Power	Speed	Package		
				PF	Plastic Thin Quad Flatpack (PN80-1)
				8	
				9	
				10	
				12	
					Speed in nanoseconds

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