HIGH-SPEED 3.3V 64K x 18 SYNCHRONOUS PIPELINED DUAL-PORT STATIC RAM WITH 3.3V OR 2.5V INTERFACE
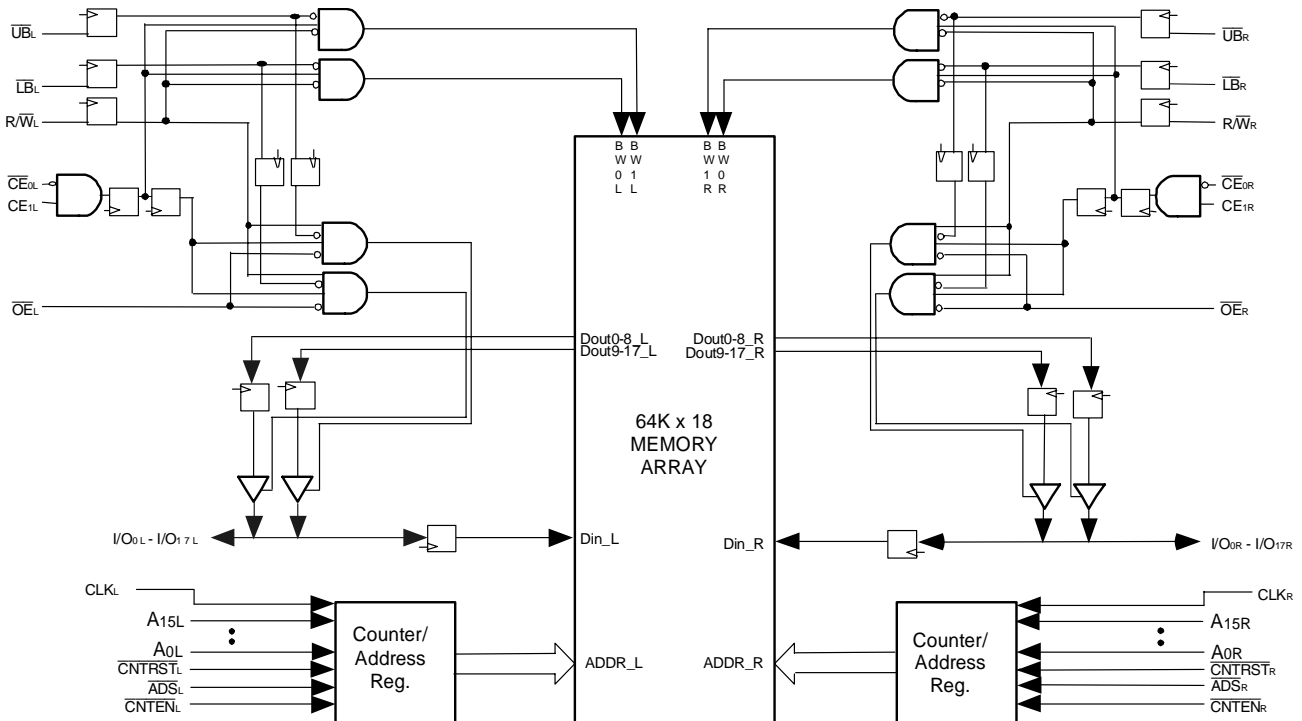
IDT70V3389S

Features

- True Dual-Port memory cells which allow simultaneous access of the same memory location
- High-speed clock to data access
  - Commercial: 4.2/5/6ns (max.)
  - Industrial: 5ns (max)
- Pipelined output mode
- Counter enable and reset features
- Dual chip enables allow for depth expansion without additional logic
- Full synchronous operation on both ports
  - 7.5ns cycle time, 133MHz operation (9.6 Gbps bandwidth)
  - Fast 4.2ns clock to data out
  - 1.8ns setup to clock and 0.7ns hold on all control, data, and address inputs @ 133MHz
  - Data input, address, byte enable and control registers
  - Self-timed write allows fast cycle time
- Separate byte controls for multiplexed bus and bus matching compatibility
- LVTTL- compatible, single 3.3V (±150mV) power supply for core
- LVTTL- compatible, selectable 3.3V (±150mV)/2.5V (±125mV) power supply for I/Os and control signals on each port
- Industrial temperature range (-40°C to +85°C) is available for selected speeds
- Available in a 128-pin Thin Quad Plastic Flatpack (TQFP), 208-pin fine pitch Ball Grid Array, and 256-pin Ball Grid Array
- Green parts available, see ordering information

Functional Block Diagram

4832 tbl 01

DSC 4832/12

Description:

The IDT70V3389 is a high-speed 64K x 18 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 IDT70V3389 has been optimized for applications having unidirectional or bidirectional data flow in bursts. An automatic power down feature, controlled by $\overline{CE}_0$ and CE_1, permits the on-chip circuitry of each port to enter a very low standby power mode.

The 70V3389 can support an I operating voltage of either 3.3V or 2.5V on one or both ports, controllable by the OPT pins. The power supply for the core of the device (V_{DD}) remains at 3.3V.

Pin Configuration[1,2,3,4]

12/12/01

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	
A	I/O_{9L}	NC	V_{SS}	NC	NC	NC	A_{12L}	A_{8L}	NC	V_{DD}	CLK_L	$\overline{CNTEN}_L$	A_{4L}	A_{0L}	OPT_L	NC	V_{SS}	**A**
B	NC	V_{SS}	NC	V_{SS}	NC	A_{13L}	A_{9L}	NC	$\overline{CE}_{0L}$	V_{SS}	$\overline{ADS}_L$	A_{5L}	A_{1L}	V_{SS}	V_{DDQR}	I/O_{8L}	NC	**B**
C	V_{DDQL}	I/O_{9R}	V_{DDQR}	V_{DD}	NC	A_{14L}	A_{10L}	$\overline{UB}_L$	CE_{1L}	V_{SS}	$R/\overline{W}_L$	A_{6L}	A_{2L}	V_{DD}	I/O_{8R}	NC	V_{SS}	**C**
D	NC	V_{SS}	I/O_{10L}	NC	A_{15L}	A_{11L}	A_{7L}	$\overline{LB}_L$	V_{DD}	$\overline{OE}_L$	$\overline{CNTRST}_L$	A_{3L}	V_{DD}	NC	V_{DDQL}	I/O_{7L}	I/O_{7R}	**D**
E	I/O_{11L}	NC	V_{DDQR}	I/O_{10R}										I/O_{6L}	NC	V_{SS}	NC	**E**
F	V_{DDQL}	I/O_{11R}	NC	V_{SS}										V_{SS}	I/O_{6R}	NC	V_{DDQR}	**F**
G	NC	V_{SS}	I/O_{12L}	NC										NC	V_{DDQL}	I/O_{5L}	NC	**G**
H	V_{DD}	NC	V_{DDQR}	I/O_{12R}				70V3389BF						V_{DD}	NC	V_{SS}	I/O_{5R}	**H**
J	V_{DDQL}	V_{DD}	V_{SS}	V_{SS}				BF-208[5]						V_{SS}	V_{DD}	V_{SS}	V_{DDQR}	**J**
K	I/O_{14R}	V_{SS}	I/O_{13R}	V_{SS}				208-Pin fpBGA						I/O_{3R}	V_{DDQL}	I/O_{4R}	V_{SS}	**K**
L	NC	I/O_{14L}	V_{DDQR}	I/O_{13L}				Top View[6]						NC	I/O_{3L}	V_{SS}	I/O_{4L}	**L**
M	V_{DDQL}	NC	I/O_{15R}	V_{SS}										V_{SS}	NC	I/O_{2R}	V_{DDQR}	**M**
N	NC	V_{SS}	NC	I/O_{15L}										I/O_{1R}	V_{DDQL}	NC	I/O_{2L}	**N**
P	I/O_{16R}	I/O_{16L}	V_{DDQR}	NC	NC	NC	A_{12R}	A_{8R}	NC	V_{DD}	CLK_R	$\overline{CNTEN}_R$	A_{4R}	NC	I/O_{1L}	V_{SS}	NC	**P**
R	V_{SS}	NC	I/O_{17R}	NC	NC	A_{13R}	A_{9R}	NC	$\overline{CE}_{0R}$	V_{SS}	$\overline{ADS}_R$	A_{5R}	A_{1R}	V_{SS}	V_{DDQL}	I/O_{0R}	V_{DDQR}	**R**
T	NC	I/O_{17L}	V_{DDQL}	V_{SS}	NC	A_{14R}	A_{10R}	$\overline{UB}_R$	CE_{1R}	V_{SS}	$R/\overline{W}_R$	A_{6R}	A_{2R}	V_{SS}	NC	V_{SS}	NC	**T**
U	V_{SS}	NC	V_{DD}	NC	A_{15R}	A_{11R}	A_{7R}	$\overline{LB}_R$	V_{DD}	$\overline{OE}_R$	$\overline{CNTRST}_R$	A_{3R}	A_{0R}	V_{DD}	OPT_R	NC	I/O_{0L}	**U**

4832 tbl 02

NOTES:
1. All V_{DD} pins must be connected to 3.3V power supply.
2. All V_{DDQ} pins must be connected to appropriate power supply: 3.3V if OPT pin for that port is set to V_{IH} (3.3V), and 2.5V if OPT pin for that port is set to V_{IL} (0V).
3. All V_{SS} pins must be connected to ground supply.
4. Package body is approximately 15mm x 15mm x 1.4mm with 0.8mm ball pitch.
5. This package code is used to reference the package diagram.
6. This text does not indicate orientation of the actual part-marking.

Pin Configuration[1,2,3,4] (con't.)

70V3389BC
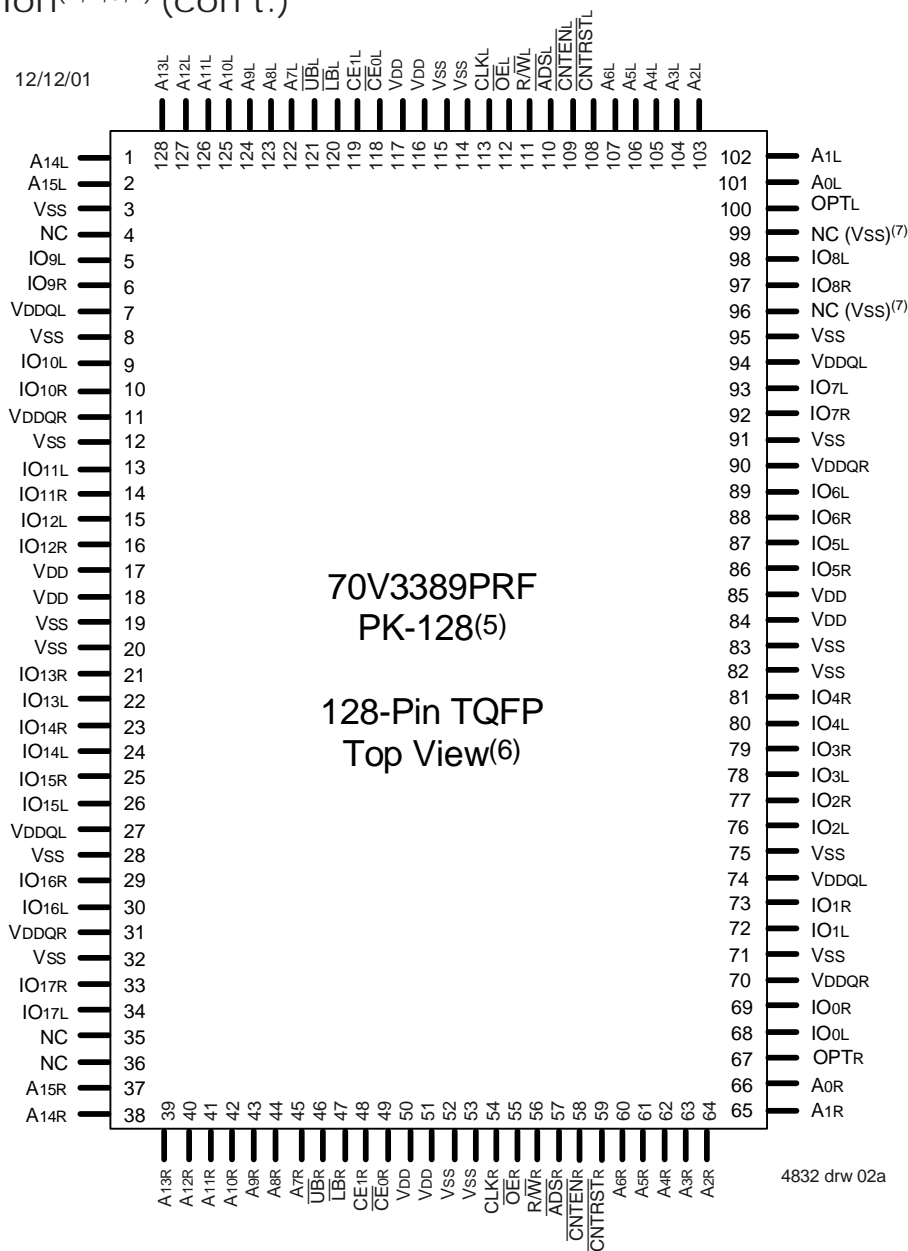**BC-256[5]**

256-Pin BGA
Top View[6]

12/12/01

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
A	NC	NC	NC	NC	A_{14L}	A_{11L}	A_{8L}	NC	$\overline{CE}_{1L}$	$\overline{OE}_L$	$\overline{CNTEN}_L$	A_{5L}	A_{2L}	A_{0L}	NC	NC
B	NC	NC	NC	NC	A_{15L}	A_{12L}	A_{9L}	$\overline{UB}_L$	$\overline{CE}_{0L}$	$R/\overline{W}_L$	$\overline{CNTRST}_L$	A_{4L}	A_{1L}	V_{DD}	NC	NC
C	NC	I/O_{9L}	V_{SS}	NC	A_{13L}	A_{10L}	A_{7L}	NC	$\overline{LB}_L$	CLK_L	$\overline{ADS}_L$	A_{6L}	A_{3L}	OPT_L	NC	I/O_{8L}
D	NC	I/O_{9R}	NC	V_{DD}	V_{DDQL}	V_{DDQL}	V_{DDQR}	V_{DDQR}	V_{DDQL}	V_{DDQL}	V_{DDQR}	V_{DDQR}	V_{DD}	NC	NC	I/O_{8R}
E	I/O_{10R}	I/O_{10L}	NC	V_{DDQL}	V_{DD}	V_{DD}	V_{SS}	V_{SS}	V_{SS}	V_{SS}	V_{DD}	V_{DD}	V_{DDQR}	NC	I/O_{7L}	I/O_{7R}
F	I/O_{11L}	NC	I/O_{11R}	V_{DDQL}	V_{DD}	V_{SS}	V_{SS}	V_{SS}	V_{SS}	V_{SS}	V_{SS}	V_{DD}	V_{DDQR}	I/O_{6R}	NC	I/O_{6L}
G	NC	NC	I/O_{12L}	V_{DDQR}	V_{SS}	V_{SS}	V_{SS}	V_{SS}	V_{SS}	V_{SS}	V_{SS}	V_{SS}	V_{DDQL}	I/O_{5L}	NC	NC
H	NC	I/O_{12R}	NC	V_{DDQR}	V_{SS}	V_{SS}	V_{SS}	V_{SS}	V_{SS}	V_{SS}	V_{SS}	V_{SS}	V_{DDQL}	NC	NC	I/O_{5R}
J	I/O_{13L}	I/O_{14R}	I/O_{13R}	V_{DDQL}	V_{SS}	V_{SS}	V_{SS}	V_{SS}	V_{SS}	V_{SS}	V_{SS}	V_{SS}	V_{DDQR}	I/O_{4R}	I/O_{3R}	I/O_{4L}
K	NC	NC	I/O_{14L}	V_{DDQL}	V_{SS}	V_{SS}	V_{SS}	V_{SS}	V_{SS}	V_{SS}	V_{SS}	V_{SS}	V_{DDQR}	NC	NC	I/O_{3L}
L	I/O_{15L}	NC	I/O_{15R}	V_{DDQR}	V_{DD}	V_{SS}	V_{SS}	V_{SS}	V_{SS}	V_{SS}	V_{SS}	V_{DD}	V_{DDQL}	I/O_{2L}	NC	I/O_{2R}
M	I/O_{16R}	I/O_{16L}	NC	V_{DDQR}	V_{DD}	V_{DD}	V_{SS}	V_{SS}	V_{SS}	V_{SS}	V_{DD}	V_{DD}	V_{DDQL}	I/O_{1R}	I/O_{1L}	NC
N	NC	I/O_{17R}	NC	V_{DD}	V_{DDQR}	V_{DDQR}	V_{DDQL}	V_{DDQL}	V_{DDQR}	V_{DDQR}	V_{DDQL}	V_{DDQL}	V_{DD}	NC	I/O_{0R}	NC
P	NC	I/O_{17L}	NC	NC	A_{13R}	A_{10R}	A_{7R}	NC	$\overline{LB}_R$	CLK_R	$\overline{ADS}_R$	A_{6R}	A_{3R}	NC	NC	I/O_{0L}
R	NC	NC	NC	NC	A_{15R}	A_{12R}	A_{9R}	$\overline{UB}_R$	$\overline{CE}_{0R}$	$R/\overline{W}_R$	$\overline{CNTRST}_R$	A_{4R}	A_{1R}	OPT_R	NC	NC
T	NC	NC	NC	NC	A_{14R}	A_{11R}	A_{8R}	NC	CE_{1R}	$\overline{OE}_R$	$\overline{CNTEN}_R$	A_{5R}	A_{2R}	A_{0R}	NC	NC

4832 drw 02c

NOTES:
1. All V_{DD} pins must be connected to 3.3V power supply.
2. All V_{DDQ} pins must be connected to appropriate power supply: 3.3V if OPT pin for that port is set to V_{IH} (3.3V), and 2.5V if OPT pin for that port is set to V_{IL} (0V).
3. All V_{SS} pins must be connected to ground supply.
4. Package body is approximately 17mm x 17mm x 1.4mm, with 1.0mm ball-pitch.
5. This package code is used to reference the package diagram.
6. This text does not indicate orientation of the actual part-marking.

Pin Configuration[1,2,3,4] (con't.)

12/12/01

Top of chip pins (left to right): A13L, A12L, A11L, A10L, A9L, A8L, A7L, UBL, LBL, CE1L, CE0L, VDD, VDD, VSS, VSS, CLKL, OEL, R/WL, ADSL, CNTENL, CNTRSTL, A6L, A5L, A4L, A3L, A2L

Left side pins:

Pin	Signal
1	A14L
2	A15L
3	VSS
4	NC
5	IO9L
6	IO9R
7	VDDQL
8	VSS
9	IO10L
10	IO10R
11	VDDQR
12	VSS
13	IO11L
14	IO11R
15	IO12L
16	IO12R
17	VDD
18	VDD
19	VSS
20	VSS
21	IO13R
22	IO13L
23	IO14R
24	IO14L
25	IO15R
26	IO15L
27	VDDQL
28	VSS
29	IO16R
30	IO16L
31	VDDQR
32	VSS
33	IO17R
34	IO17L
35	NC
36	NC
37	A15R
38	A14R

Top numbers (left to right): 128, 127, 126, 125, 124, 123, 122, 121, 120, 119, 118, 117, 116, 115, 114, 113, 112, 111, 110, 109, 108, 107, 106, 105, 104, 103

Right numbers (top to bottom): 102, 101, 100, 99, 98, 97, 96, 95, 94, 93, 92, 91, 90, 89, 88, 87, 86, 85, 84, 83, 82, 81, 80, 79, 78, 77, 76, 75, 74, 73, 72, 71, 70, 69, 68, 67, 66, 65

Center text:

70V3389PRF
PK-128[5]

128-Pin TQFP
Top View[6]

Right side pins:

Pin	Signal
102	A1L
101	A0L
100	OPTL
99	NC (VSS)[7]
98	IO8L
97	IO8R
96	NC (VSS)[7]
95	VSS
94	VDDQL
93	IO7L
92	IO7R
91	VSS
90	VDDQR
89	IO6L
88	IO6R
87	IO5L
86	IO5R
85	VDD
84	VDD
83	VSS
82	VSS
81	IO4R
80	IO4L
79	IO3R
78	IO3L
77	IO2R
76	IO2L
75	VSS
74	VDDQL
73	IO1R
72	IO1L
71	VSS
70	VDDQR
69	IO0R
68	IO0L
67	OPTR
66	A0R
65	A1R

Bottom numbers (left to right): 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64

Bottom of chip pins (left to right): A13R, A12R, A11R, A10R, A9R, A8R, A7R, UBR, LBR, CE1R, CE0R, VDD, VDD, VSS, VSS, CLKR, OER, R/WR, ADSR, CNTENR, CNTRSTR, A6R, A5R, A4R, A3R, A2R

4832 drw 02a

NOTES:
1. All VDD pins must be connected to 3.3V power supply.
2. All VDDQ pins must be connected to appropriate power supply: 3.3V if OPT pin for that port is set to VIH (3.3V), and 2.5V if OPT pin for that port is set to VIL (0V).
3. All VSS pins must be connected to ground supply.
4. Package body is approximately 14mm x 20mm x 1.4mm.
5. This package code is used to reference the package diagram.
6. This text does not indicate orientation of the actual part-marking.
7. In the 70V3379 (32K x 18) and 70V3389 (64K x 18), pins 96 and 99 are NC. The upgrade devices 70V3399 (128K x 18) and 70V3319 (256K x 18) assign these pins as VSS. Customers who plan to take advantage of the upgrade path should treat these pins as VSS on the 70V3379 and 70V3389. If no upgrade is needed, the pins can be treated as NC.

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}	A_{0R} - A_{15R}	Address
I/O_{0L} - I/O_{17L}	I/O_{0R} - I/O_{17R}	Data Input/Output
CLK_L	CLK_R	Clock
$\overline{ADS}_L$	$\overline{ADS}_R$	Address Strobe Enable
$\overline{CNTEN}_L$	$\overline{CNTEN}_R$	Counter Enable
$\overline{CNTRST}_L$	$\overline{CNTRST}_R$	Counter Reset
UB_L - LB_L	UB_R - LB_R	Byte Enables (9-bit bytes)
V_{DDQL}	V_{DDQR}	Power (I/O Bus) (3.3V or 2.5V)[1]
OPT_L	OPT_R	Option for selecting V_{DDQX}[1,2]
V_{DD}		Power (3.3V)[1]
V_{SS}		Ground (0V)

4832 tbl 01

NOTES:
1. V_{DD}, OPT_X, and V_{DDQX} must be set to appropriate operating levels prior to applying inputs on the I/Os and controls for that port.
2. OPT_X selects the operating voltage levels for the I/Os and controls on that port. If OPT_X is set to VIH (3.3V), then that port's I/Os and controls will operate at 3.3V levels and V_{DDQX} must be supplied at 3.3V. If OPT_X is set to VIL (0V), then that port's I/Os and controls will operate at 2.5V levels and V_{DDQX} must be supplied at 2.5V. The OPT pins are independent of one another—both ports can operate at 3.3V levels, both can operate at 2.5V levels, or either can operate at 3.3V with the other at 2.5V.

Truth Table I—Read/Write and Enable Control[1,2,3]

$\overline{OE}$	CLK	$\overline{CE}_0$	CE_1	$\overline{UB}$	$\overline{LB}$	$R/\overline{W}$	Upper Byte I/O$_{9-18}$	Lower Byte I/O$_{0-8}$	MODE
X	↑	L	H	H	H	X	High-Z	High-Z	All Bytes Deselected
X	↑	L	H	H	L	L	High-Z	D_{IN}	Write to Lower Byte Only
X	↑	L	H	L	H	L	D_{IN}	High-Z	Write to Upper Byte Only
X	↑	L	H	L	L	L	D_{IN}	D_{IN}	Write to Both Bytes
L	↑	L	H	H	L	H	High-Z	D_{OUT}	Read Lower Byte Only
L	↑	L	H	L	H	H	D_{OUT}	High-Z	Read Upper Byte Only
L	↑	L	H	L	L	H	D_{OUT}	D_{OUT}	Read Both Bytes
H	↑	L	H	L	L	X	High-Z	High-Z	Outputs Disabled

4832 tbl 02

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

Truth Table II—Address Counter Control[1,2]

Address	Previous Address	Addr Used	CLK	$\overline{ADS}$	$\overline{CNTEN}$	$\overline{CNTRST}$	I/O[3]	MODE
X	X	0	↑	X	X	L[4]	$D_{I/O}(0)$	Counter Reset to Address 0
An	X	An	↑	L[4]	X	H	$D_{I/O}(n)$	External Address Used
An	Ap	Ap	↑	H	H	H	$D_{I/O}(p)$	External Address Blocked—Counter disabled (Ap reused)
X	Ap	Ap + 1	↑	H	L[5]	H	$D_{I/O}(p+1)$	Counter Enabled—Internal Address generation

4832 tbl 03

NOTES:
1. "H" = V_{IH}, "L" = V_{IL}, "X" = Don't Care.
2. Read and write operations are controlled by the appropriate setting of R/$\overline{W}$, $\overline{CE}_0$, CE$_1$, $\overline{BE}$n and $\overline{OE}$.
3. Outputs are in Pipelined mode: the data out will be delayed by one cycle.
4. $\overline{ADS}$ and $\overline{CNTRST}$ are independent of all other memory control signals including $\overline{CE}_0$, CE$_1$ and $\overline{BE}$n
5. The address counter advances if $\overline{CNTEN}$ = V_{IL} on the rising edge of CLK, regardless of all other memory control signals including $\overline{CE}_0$, CE$_1$, $\overline{BE}$n.

Recommended Operating Temperature and Supply Voltage[1]

Grade	Ambient Temperature	GND	V_{DD}
Commercial	0°C to +70°C	0V	3.3V ± 150mV
Industrial	-40°C to +85°C	0V	3.3V ± 150mV

4832 tbl 04

NOTES:
1. Industrial temperature: for specific speeds, packages and powers contact your sales office.

Absolute Maximum Ratings[1]

Symbol	Rating	Commercial & Industrial	Unit
V_{TERM}[2]	Terminal Voltage with Respect to GND	-0.5 to +4.6	V
T_{BIAS}	Temperature Under Bias	-55 to +125	°C
T_{STG}	Storage Temperature	-65 to +150	°C
I_{OUT}	DC Output Current	50	mA

4832 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_{TERM} must not exceed V_{DD} + 150mV for more than 25% of the cycle time or 4ns maximum, and is limited to ≤ 20mA for the period of $V_{TERM} \geq V_{DD}$ + 150mV.

Recommended DC Operating Conditions with V_{DDQ} at 2.5V

Symbol	Parameter	Min.	Typ.	Max.	Unit
V_{DD}	Core Supply Voltage	3.15	3.3	3.45	V
V_{DDQ}	I/O Supply Voltage[3]	2.375	2.5	2.625	V
V_{SS}	Ground	0	0	0	V
V_{IH}	Input High Voltage[3] (Address & Control Inputs)	1.7	—	V_{DDQ} + 125mV[2]	V
V_{IH}	Input High Voltage - I/O[3]	1.7	—	V_{DDQ} + 125mV[2]	V
V_{IL}	Input Low Voltage	-0.3[1]	—	0.7	V

4832 tbl 05a

NOTES:
1. $V_{IL} \geq$ -1.5V for pulse width less than 10 ns.
2. V_{TERM} must not exceed V_{DDQ} + 125mV.
3. To select operation at 2.5V levels on the I/Os and controls of a given port, the OPT pin for that port must be set to V_{IL} (0V), and V_{DDQX} for that port must be supplied as indicated above.

Recommended DC Operating Conditions with V_{DDQ} at 3.3V

Symbol	Parameter	Min.	Typ.	Max.	Unit
V_{DD}	Core Supply Voltage	3.15	3.3	3.45	V
V_{DDQ}	I/O Supply Voltage[3]	3.15	3.3	3.45	V
V_{SS}	Ground	0	0	0	V
V_{IH}	Input High Voltage (Address & Control Inputs)[3]	2.0	—	V_{DDQ} + 150mV[2]	V
V_{IH}	Input High Voltage - I/O[3]	2.0	—	V_{DDQ} + 150mV[2]	V
V_{IL}	Input Low Voltage	-0.3[1]	—	0.8	V

4832 tbl 05b

NOTES:
1. $V_{IL} \geq$ -1.5V for pulse width less than 10 ns.
2. V_{TERM} must not exceed V_{DDQ} + 150mV.
3. To select operation at 3.3V levels on the I/Os and controls of a given port, the OPT pin for that port must be set to V_{IH} (3.3V), and V_{DDQX} for that port must be supplied as indicated above.

Capacitance[1]

(T$_A$ = +25°C, F = 1.0MHz) TQFP ONLY

Symbol	Parameter	Conditions[2]	Max.	Unit
C$_{IN}$	Input Capacitance	V$_{IN}$ = 3dV	8	pF
C$_{OUT}$[3]	Output Capacitance	V$_{OUT}$ = 3dV	10.5	pF

4832 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$_{OUT}$ also references C$_{I/O}$.

DC Electrical Characteristics Over the Operating Temperature and Supply Voltage Range (V$_{DD}$ = 3.3V ± 150mV)

Symbol	Parameter	Test Conditions	70V3389S		Unit
			Min.	Max.	
|I$_{LI}$|	Input Leakage Current[1]	V$_{DDQ}$ = Max., V$_{IN}$ = 0V to V$_{DDQ}$	—	10	µA
|I$_{LO}$|	Output Leakage Current	$\overline{CE}$0 = V$_{IH}$ or CE1 = V$_{IL}$, V$_{OUT}$ = 0V to V$_{DDQ}$	—	10	µA
V$_{OL}$ (3.3V)	Output Low Voltage[2]	I$_{OL}$ = +4mA, V$_{DDQ}$ = Min.	—	0.4	V
V$_{OH}$ (3.3V)	Output High Voltage[2]	I$_{OH}$ = -4mA, V$_{DDQ}$ = Min.	2.4	—	V
V$_{OL}$ (2.5V)	Output Low Voltage[2]	I$_{OL}$ = +2mA, V$_{DDQ}$ = Min.	—	0.4	V
V$_{OH}$ (2.5V)	Output High Voltage[2]	I$_{OH}$ = -2mA, V$_{DDQ}$ = Min.	2.0	—	V

4832 tbl 08

NOTE:
1. At V$_{DD}$ ≤ - 2.0V input leakages are undefined.
2. V$_{DDQ}$ is selectable (3.3V/2.5V) via OPT pins. Refer to p.4 for details.

DC Electrical Characteristics Over the Operating Temperature and Supply Voltage Range[3] (V_{DD} = 3.3V ± 150mV)

Symbol	Parameter	Test Condition	Version		70V3389S4 Com'l Only Typ.[4]	Max.	70V3389S5 Com'l & Ind Typ.[4]	Max.	70V3389S6 Com'l Only Typ.[4]	Max.	Unit
I_{DD}	Dynamic Operating Current (Both Ports Active)	$\overline{CE}_L$ and $\overline{CE}_R$= V_{IL}, Outputs Disabled, f = f_{MAX}[1]	COM'L	S	375	460	285	360	245	310	mA
			IND	S	—	—	285	415	245	360	
I_{SB1}	Standby Current (Both Ports - TTL Level Inputs)	$\overline{CE}_L$ = $\overline{CE}_R$ = V_{IH} f = f_{MAX}[1]	COM'L	S	145	190	105	145	95	125	mA
			IND	S	—	—	105	175	95	150	
I_{SB2}	Standby Current (One Port - TTL Level Inputs)	$\overline{CE}$"A" = V_{IL} and $\overline{CE}$"B" = V_{IH}[5] Active Port Outputs Disabled, f=f_{MAX}[1]	COM'L	S	265	325	190	260	175	225	mA
			IND	S	—	—	190	300	175	260	
I_{SB3}	Full Standby Current (Both Ports - CMOS Level Inputs)	Both Ports $\overline{CE}_L$ and $\overline{CE}_R$ ≥ V_{DDQ} - 0.2V, V_{IN} ≥ V_{DDQ} - 0.2V or V_{IN} ≤ 0.2V, f = 0[2]	COM'L	S	6	15	6	15	6	15	mA
			IND	S	—	—	6	30	6	30	
I_{SB4}	Full Standby Current (One Port - CMOS Level Inputs)	$\overline{CE}$"A" ≤ 0.2V and $\overline{CE}$"B" ≥ V_{DDQ} - 0.2V[5] V_{IN} ≥ V_{DDQ} - 0.2V or V_{IN} ≤ 0.2V, Active Port, Outputs Disabled, f = f_{MAX}[1]	COM'L	S	265	325	180	260	170	225	mA
			IND	S	—	—	180	300	170	260	

4832 tbl 09

NOTES:

1. At f = f_{MAX}, address and control lines (except Output Enable) are cycling at the maximum frequency clock cycle of 1/t_{CYC}, using "AC TEST CONDITIONS" at input levels of GND to 3V.
2. f = 0 means no address, clock, or control lines change. Applies only to input at CMOS level standby.
3. Port "A" may be either left or right port. Port "B" is the opposite from port "A".
4. V_{DD} = 3.3V, T_A = 25°C for Typ, and are not production tested. I_{DD} DC(f=0) = 120mA (Typ).
5. $\overline{CE}_X$ = 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}
   $\overline{CE}_X$ ≤ 0.2V means $\overline{CE}_{0X}$ ≤ 0.2V and CE_{1X} ≥ V_{DDQ} - 0.2V
   $\overline{CE}_X$ ≥ V_{DDQ} - 0.2V means $\overline{CE}_{0X}$ ≥ V_{DDQ} - 0.2V or CE_{1X} - 0.2V
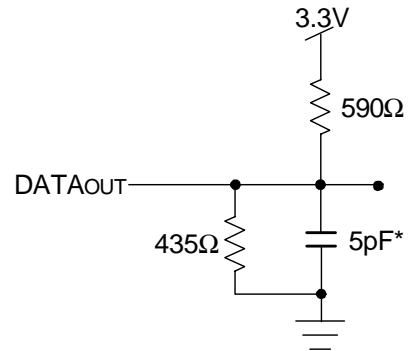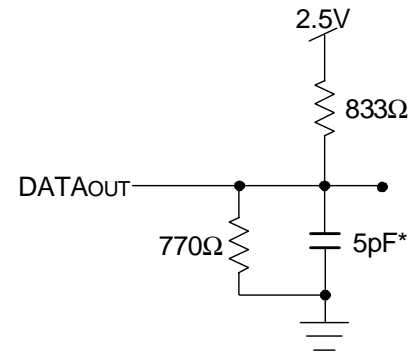   "X" represents "L" for left port or "R" for right port.

AC Test Conditions

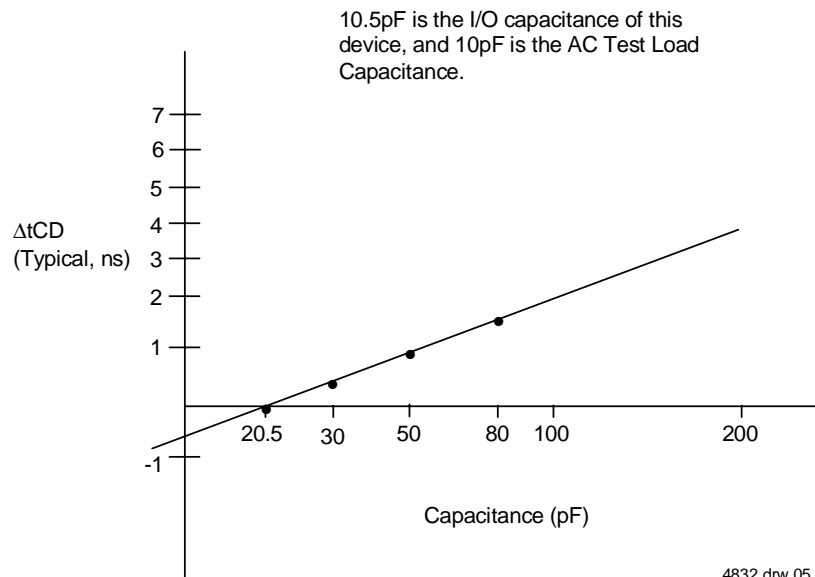|	
Input Pulse Levels (Address & Controls)	GND to 3.0V/GND to 2.35V
Input Pulse Levels (I/Os)	GND to 3.0V/GND to 2.35V
Input Rise/Fall Times	3ns
Input Timing Reference Levels	1.5V/1.25V
Output Reference Levels	1.5V/1.25V
Output Load	Figures 1, 2, and 3

4832 tbl 10
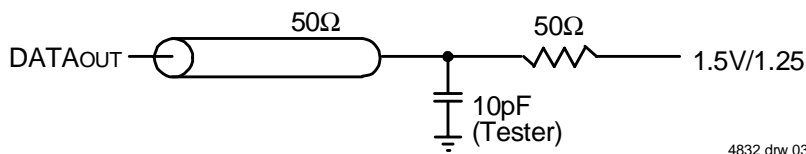
Figure 1. AC Output Test load.

Figure 2. Output Test Load
(For t_{CKLZ}, t_{CKHZ}, t_{OLZ}, and t_{OHZ}).
*Including scope and jig.

10.5pF is the I/O capacitance of this device, and 10pF is the AC Test Load Capacitance.

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

AC Electrical Characteristics Over the Operating Temperature Range (Read and Write Cycle Timing)[1,2]
(V_{DD} = 3.3V ± 150mV, T_A = 0°C to +70°C)

Symbol	Parameter	70V3389S4 Com'l Only Min.	70V3389S4 Com'l Only Max.	70V3389S5 Com'l & Ind Min.	70V3389S5 Com'l & Ind Max.	70V3389S6 Com'l Only Min.	70V3389S6 Com'l Only Max.	Unit
t_{CYC2}	Clock Cycle Time (Pipelined)	7.5	—	10	—	12	—	ns
t_{CH2}	Clock High Time (Pipelined)	3	—	4	—	5	—	ns
t_{CL2}	Clock Low Time (Pipelined)	3	—	4	—	5	—	ns
t_R	Clock Rise Time	—	3	—	3	—	3	ns
t_F	Clock Fall Time	—	3	—	3	—	3	ns
t_{SA}	Address Setup Time	1.8	—	2.0	—	2.0	—	ns
t_{HA}	Address Hold Time	0.7	—	0.7	—	1.0	—	ns
t_{SC}	Chip Enable Setup Time	1.8	—	2.0	—	2.0	—	ns
t_{HC}	Chip Enable Hold Time	0.7	—	0.7	—	1.0	—	ns
t_{SB}	Byte Enable Setup Time	1.8	—	2.0	—	2.0	—	ns
t_{HB}	Byte Enable Hold Time	0.7	—	0.7	—	1.0	—	ns
t_{SW}	R/$\overline{W}$ Setup Time	1.8	—	2.0	—	2.0	—	ns
t_{HW}	R/$\overline{W}$ Hold Time	0.7	—	0.7	—	1.0	—	ns
t_{SD}	Input Data Setup Time	1.8	—	2.0	—	2.0	—	ns
t_{HD}	Input Data Hold Time	0.7	—	0.7	—	1.0	—	ns
t_{SAD}	$\overline{ADS}$ Setup Time	1.8	—	2.0	—	2.0	—	ns
t_{HAD}	$\overline{ADS}$ Hold Time	0.7	—	0.7	—	1.0	—	ns
t_{SCN}	$\overline{CNTEN}$ Setup Time	1.8	—	2.0	—	2.0	—	ns
t_{HCN}	$\overline{CNTEN}$ Hold Time	0.7	—	0.7	—	1.0	—	ns
t_{SRST}	$\overline{CNTRST}$ Setup Time	1.8	—	2.0	—	2.0	—	ns
t_{HRST}	$\overline{CNTRST}$ Hold Time	0.7	—	0.7	—	1.0	—	ns
t_{OE}[1]	Output Enable to Data Valid	—	4	—	5	—	6	ns
t_{OLZ}	Output Enable to Output Low-Z	0	—	0	—	0	—	ns
t_{OHZ}	Output Enable to Output High-Z	1	4	1	4.5	1	5	ns
t_{CD2}	Clock to Data Valid (Pipelined)	—	4.2	—	5	—	6	ns
t_{DC}	Data Output Hold After Clock High	1	—	1	—	1	—	ns
t_{CKHZ}	Clock High to Output High-Z	1	3	1	4.5	1.5	6	ns
t_{CKLZ}	Clock High to Output Low-Z	1	—	1	—	1	—	ns
Port-to-Port Delay								
t_{CO}	Clock-to-Clock Offset	6	—	8	—	10	—	ns

4830 tbl 11

NOTES:
1. All input signals are synchronous with respect to the clock except for the asynchronous Output Enable ($\overline{OE}$).
2. These values are valid for either level of V_{DDQ} (3.3V/2.5V). See page 4 for details on selecting the desired I/O voltage levels for each port.

## Timing Waveform of Read Cycle for Pipelined Operation[2]

4832 drw 06
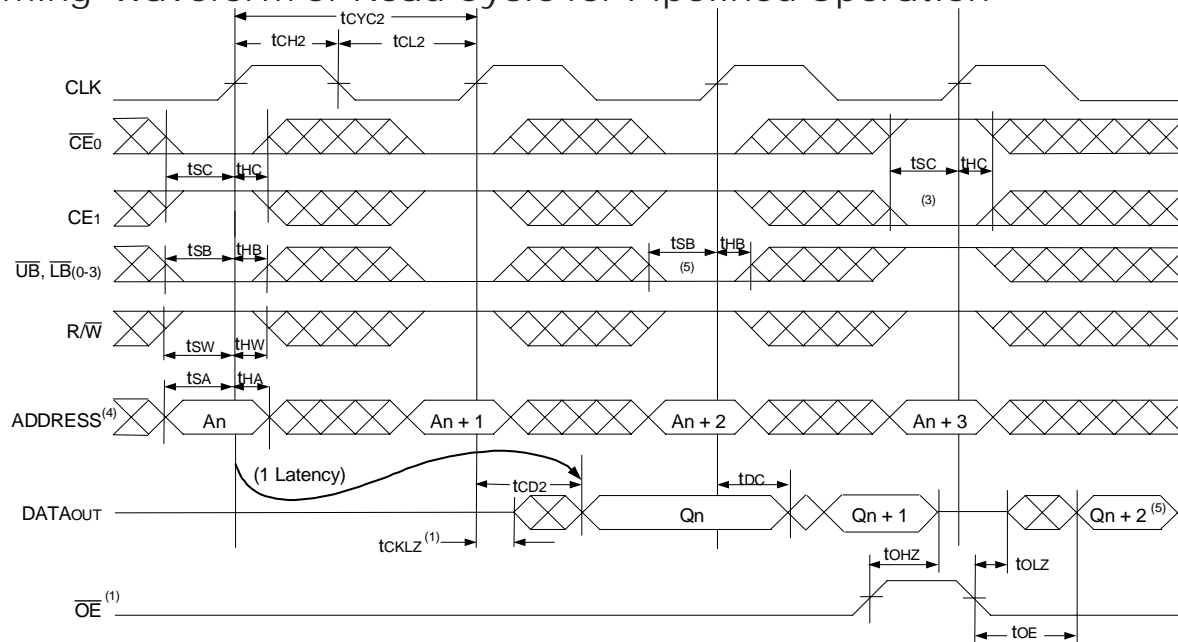
NOTES:
1. $\overline{OE}$ is asynchronously controlled; all other inputs are synchronous to the rising clock edge.
2. $\overline{ADS}$ = V_{IL}, $\overline{CNTEN}$ and $\overline{CNTRST}$ = V_{IH}.
3. The output is disabled (High-Impedance state) by $\overline{CE}_0$ = V_{IH}, CE1 = V_{IL}, $\overline{UB}$, $\overline{LB}$ = V_{IH} following the next rising edge of the clock. Refer to Truth Table 1.
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. If $\overline{UB}$ or $\overline{LB}$ was HIGH, then the appropriate Byte of DATAOUT for Qn + 2 would be disabled (High-Impedance state).

Timing Waveform of a Multi-Device Pipelined Read[1,2]

4832 drw 07
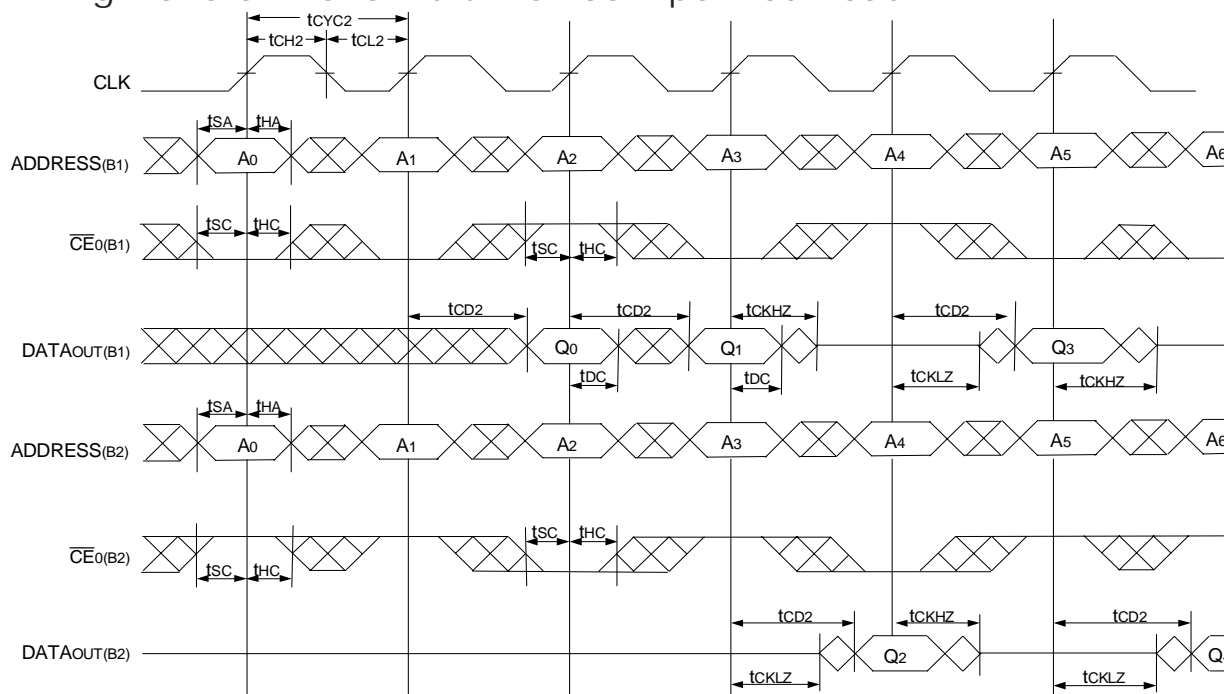
NOTES:
1. B1 Represents Device #1; B2 Represents Device #2. Each Device consists of one IDT70V3389 for this waveform, and are setup for depth expansion in this example. ADDRESS(B1) = ADDRESS(B2) in this situation.
2. $\overline{UB}$, $\overline{LB}$, $\overline{OE}$, and $\overline{ADS}$ = V_{IL}; CE1(B1), CE1(B2), R/$\overline{W}$, $\overline{CNTEN}$, and $\overline{CNTRST}$ = V_{IH}.

Timing Waveform of Left Port Write to Pipelined Right Port Read[1,2]

4832 drw 08
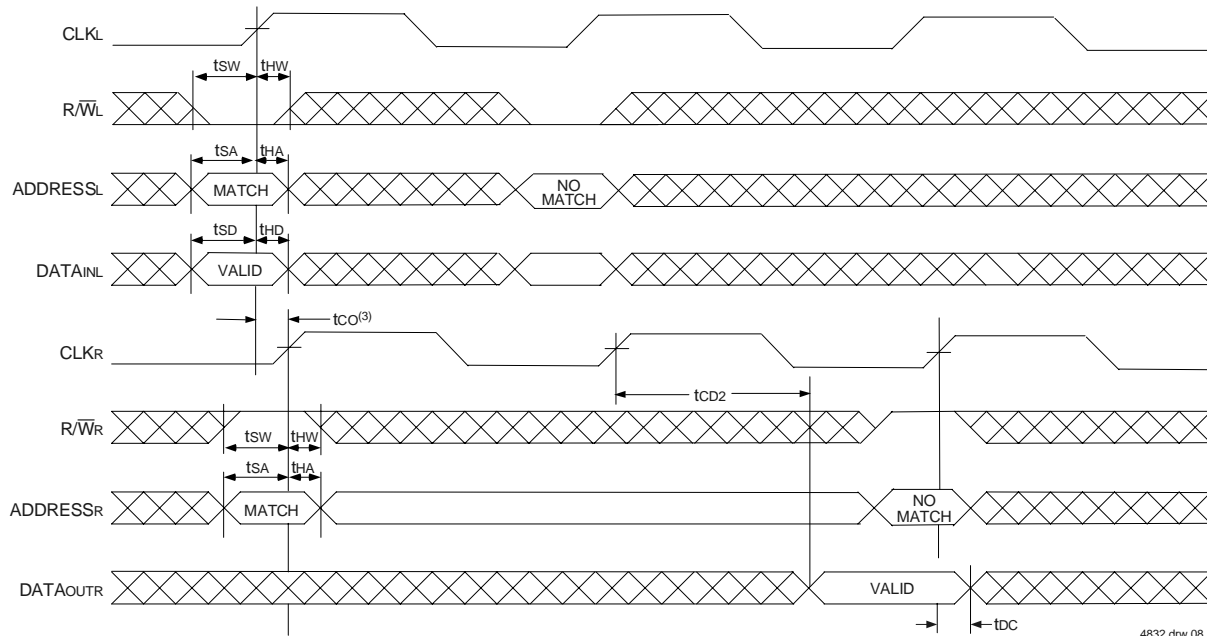
NOTES:
1. $\overline{CE_0}$, $\overline{UB}$, $\overline{LB}$, and $\overline{ADS}$ = V_{IL}; CE_1, $\overline{CNTEN}$, and $\overline{CNTRST}$ = V_{IH}.
2. $\overline{OE}$ = V_{IL} for the Right Port, which is being read from. $\overline{OE}$ = V_{IH} for the Left Port, which is being written to.
3. If $t_{CO} \leq$ minimum specified, then data from right port read is not valid until following right port clock cycle (ie, time from write to valid read on opposite port will be t_{CO} + 2 t_{CYC2} + t_{CD2}). If t_{CO} > minimum, then data from right port read is available on first right port clock cycle (ie, time from write to valid read on opposite port will be t_{CO} + t_{CYC} + t_{CD2}).

Timing Waveform of Pipelined Read-to-Write-to-Read ($\overline{OE}$ = V_{IL})[2]
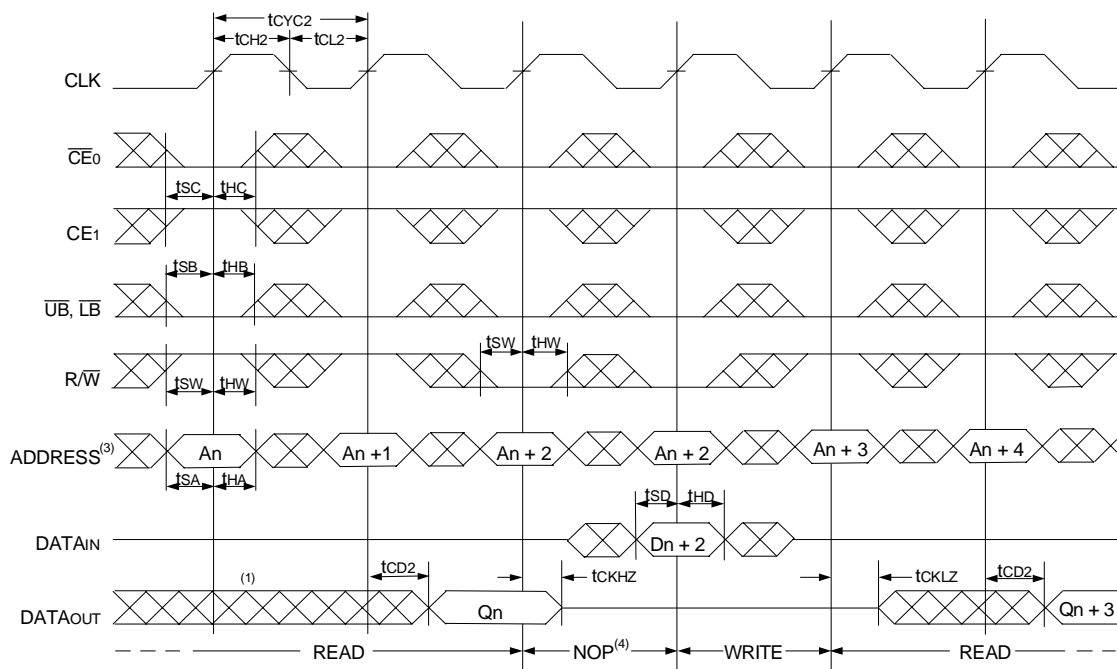
4832 drw 09

NOTES:
1. Output state (High, Low, or High-impedance) is determined by the previous cycle control signals.
2. $\overline{CE_0}$, $\overline{UB}$, $\overline{LB}$, and $\overline{ADS}$ = V_{IL}; CE_1, $\overline{CNTEN}$, and $\overline{CNTRST}$ = V_{IH}. "NOP" is "No Operation".
3. 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.
4. "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-to-Write-to-Read ($\overline{\text{OE}}$ Controlled)[2]
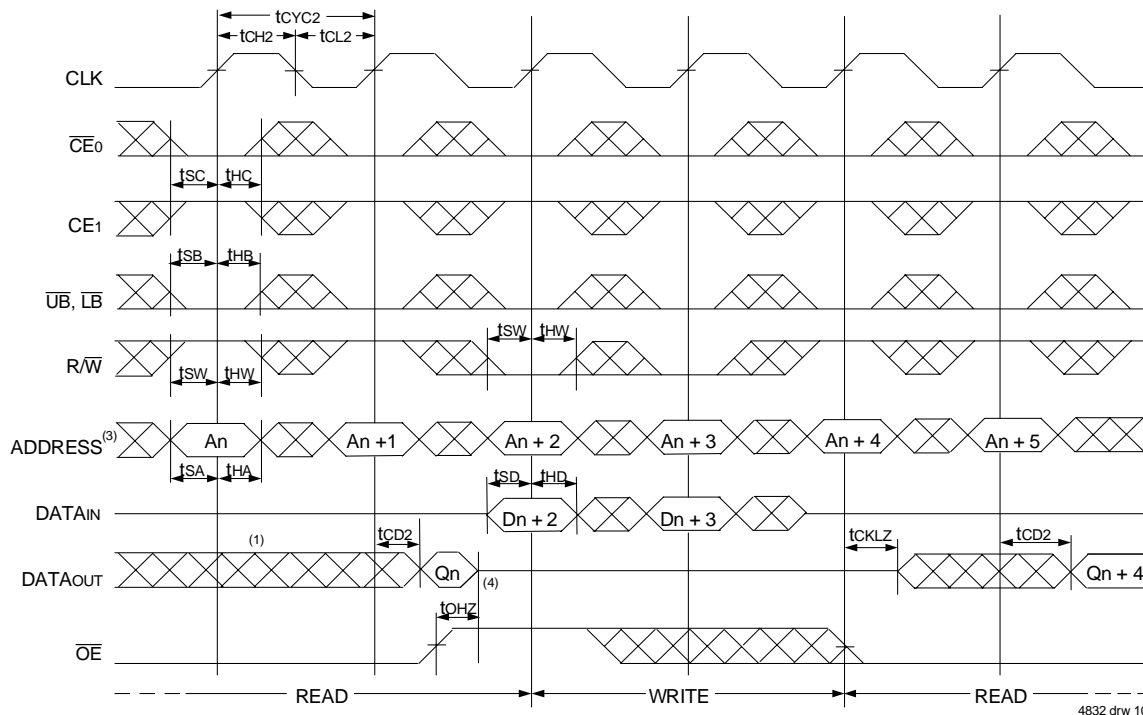
4832 drw 10

NOTES:
1. Output state (High, Low, or High-impedance) is determined by the previous cycle control signals.
2. $\overline{\text{CE}}_0$, $\overline{\text{UB}}$, $\overline{\text{LB}}$, and $\overline{\text{ADS}}$ = V_{IL}; CE_1, $\overline{\text{CNTEN}}$, and $\overline{\text{CNTRST}}$ = V_{IH}.
3. Addresses do not have to be accessed sequentially since $\overline{\text{ADS}}$ = V_{IL} constantly loads the address on the rising edge of the CLK; numbers are for reference use only.
4. This timing does not meet requirements for fastest speed grade. This waveform indicates how logically it could be done if timing so allows.

## Timing Waveform of Pipelined Read with Address Counter Advance[1]

4832 drw 11
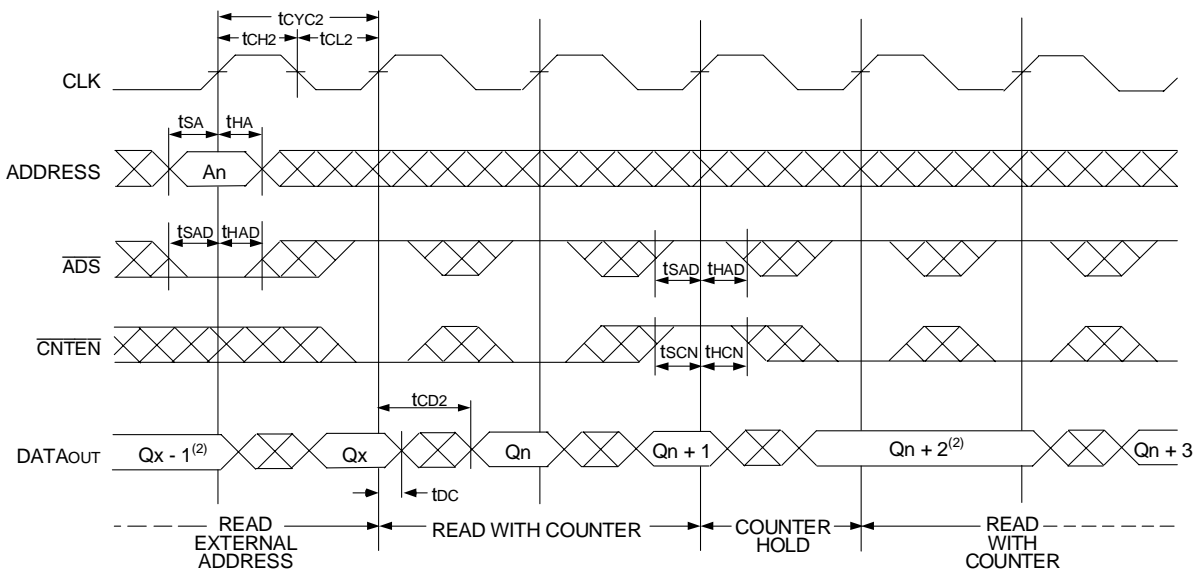
NOTES:
1. $\overline{\text{CE}}_0$, $\overline{\text{OE}}$, $\overline{\text{UB}}$, $\overline{\text{LB}}$ = V_{IL}; CE_1, $R/\overline{W}$, and $\overline{\text{CNTRST}}$ = V_{IH}.
2. If there is no address change via $\overline{\text{ADS}}$ = V_{IL} (loading a new address) or $\overline{\text{CNTEN}}$ = V_{IL} (advancing the address), i.e. $\overline{\text{ADS}}$ = V_{IH} and $\overline{\text{CNTEN}}$ = V_{IH}, then the data output remains constant for subsequent clocks.

Timing Waveform of Write with Address Counter Advance[1]

4832 drw 12
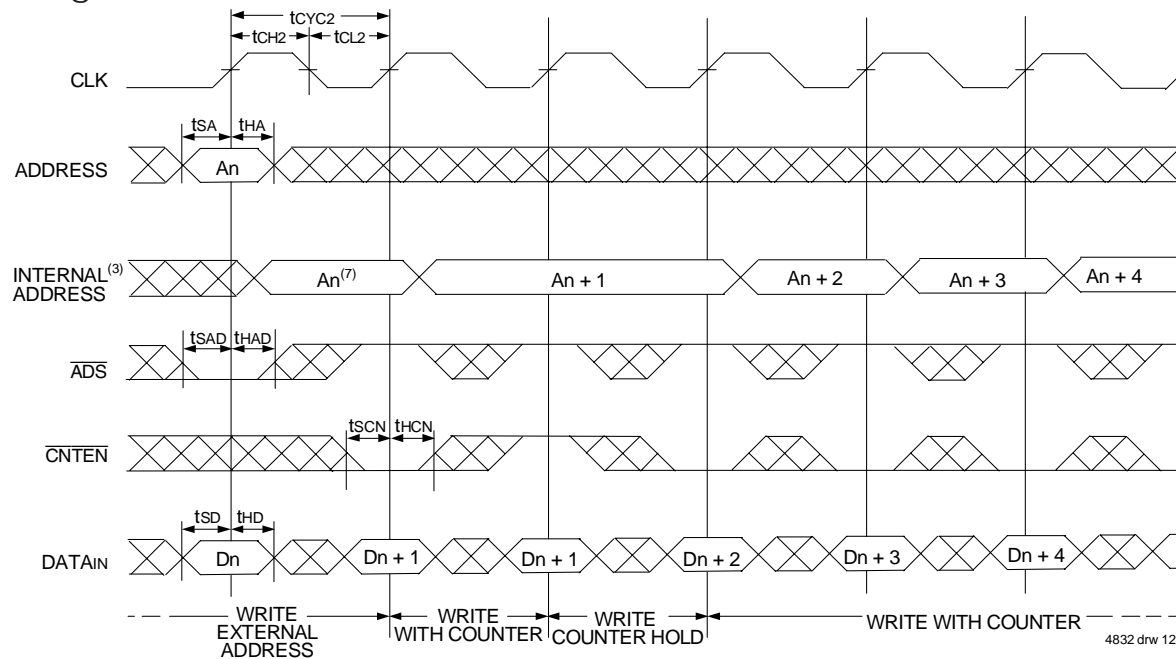
Timing Waveform of Counter Reset[2]

4832 drw 13
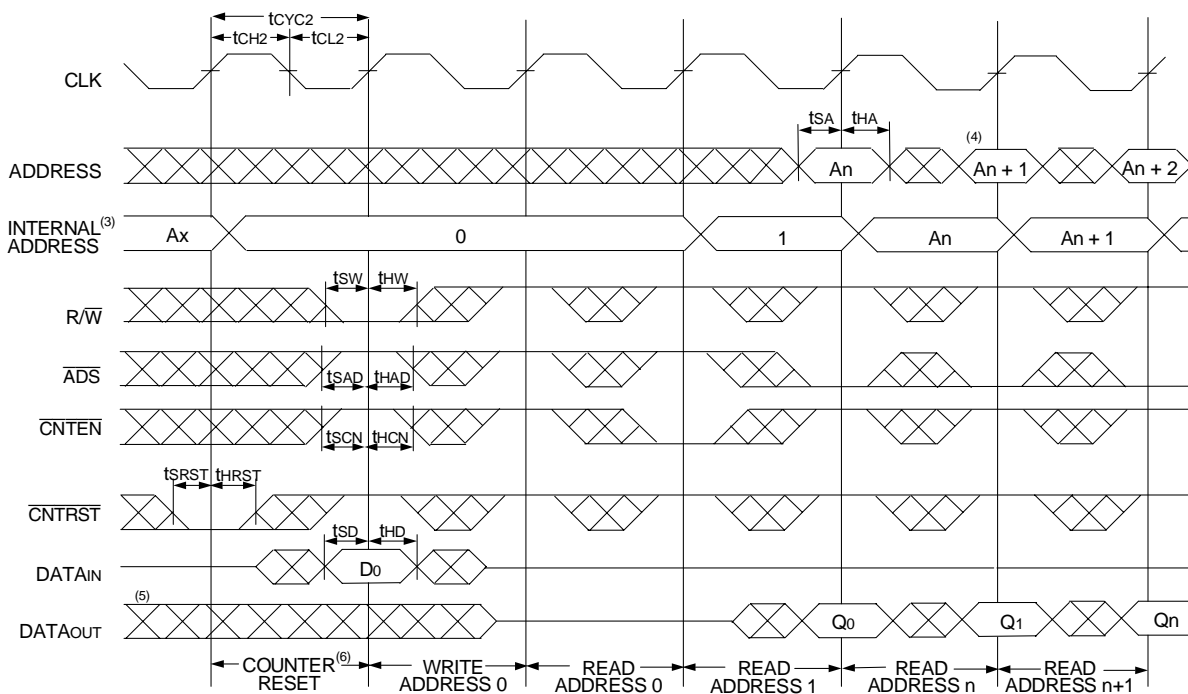
NOTES:
1. $\overline{CE}_0$, $\overline{UB}$, $\overline{LB}$, and R/$\overline{W}$ = V$_{IL}$; CE$_1$ and $\overline{CNTRST}$ = V$_{IH}$.
2. $\overline{CE}_0$, $\overline{UB}$, $\overline{LB}$ = V$_{IL}$; CE$_1$ = V$_{IH}$.
3. The "Internal Address" is equal to the "External Address" when $\overline{ADS}$ = 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 cycle: 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 IDT70V3389 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 IDT70V3389s for depth expansion configurations. Two cycles are required with $\overline{CE}_0$ LOW and CE_1 HIGH to re-activate the outputs.

Depth and Width Expansion

The IDT70V3389 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 IDT70V3389 can also be used in applications requiring expanded width, as indicated in Figure 4. Through combining the control signals, the devices can be grouped as necessary to accommodate applications needing 36-bits or wider.
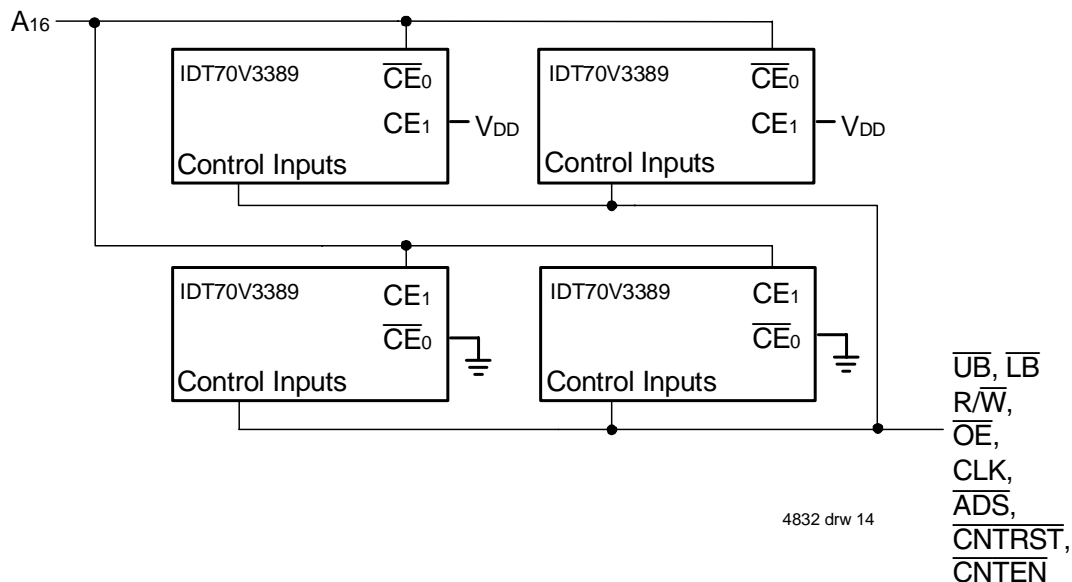

4832 drw 14

Figure 4. Depth and Width Expansion with IDT70V3389

Ordering Information

```
XXXXX      A      99      A      A      A
Device   Power   Speed  Package      Process/
Type                                Temperature
                                     Range
```

Blank	Commercial (0°C to +70°C)	
I[1]	Industrial (-40°C to +85°C)	
G[2]	Green	
BF	208-pin fpBGA (BF-208)	
PRF	128-pin TQFP (PK-128)	
BC	256-pin BGA (BC-256)	
4	Commercial Only	Speed in
5	Commercial & Industrial	nanoseconds
6	Commercial Only	
S	Standard Power	
70V3389	1Mbit (64K x 18-Bit) 3.3V Synchronous Dual-Port RAM	

4832 drw 15A

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

Datasheet Document History (cont'd)

01/18/99:   Initial Public Release

03/15/99:   Page 9   Additional notes

04/28/99:   Added fpBGA paclage

06/08/99:   Page 2   Changed package body height from 1.5mm to 1.4mm

06/15/99:   Page 5   Deleted note 6 for Table II

0714//99:   Page 2   Corrected pin T3 to V_{DDQL}

08/04/99:   Page 6   Improved power numbers

10/01/99:   Upgraded speed to 133MHz, added 2.5V I/O capability

11/12/99:   Replaced IDT logo

02/28/00:   Added new BGA package, added full 2.5V interface capability

05/01/00:   Page 2   Added ball pitch

                   Page 3   Renamed pins

                   Page 6   Made corrections to Truth Table

                   Page 9   Changed Ω numbers in figure 2

01/10/01:   Page 4   Added information to pin and pin notes

                   Page 6   Increated storage temperature parameter

                                 Clarified T_A Parameter

                   Page 8   DC Electrical parameters–changed wording from "open" to "disabled"

                               Removed note 7 on DC Characteristics table

                               Removed Preliminary status

04/10/01:   Added Industrial Temperature Ranges and removed related notes

12/12/01:   Page 2,   Added date revision to pin configurations
3 & 4

                   Page 6   Removed industrial temp footnote from table 04

                   Page 8   Removed industrial temp for 6ns from DC & AC Electrical Characteristic
& 10

                   Page 16   Removed industrial temp from 6ns in ordering information

                               Added industrial temp footnote

                   Page 1   Replaced ™ logo with ® logo
& 17

01/05/06:   Page 1   Added green availability to features

                   Page 16   Added green indicator to ordering information

02/08/06:   Page 5   Changed footnote 2 for Truth Table I from $\overline{ADS}$, $\overline{CNTEN}$, $\overline{CNTRST}$ = V_{IH} to $\overline{ADS}$, $\overline{CNTEN}$, $\overline{CNTRST}$ = X

07/25/08:   Page 8   Corrected a typo in the DC Chars table

01/19/09:   Page 16   Removed "IDT" from orderable part number