

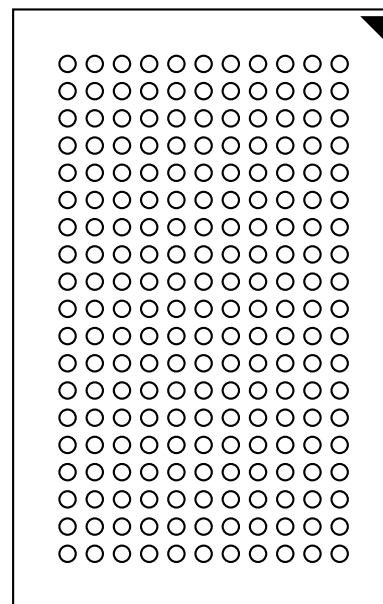
## $\Sigma$ RAM 256K X 72, 512K X 36

## 18MB SYNCHRONOUS SRAM

ADVANCE INFORMATION  
JUNE 2002

### FEATURES

- JEDEC SigmaRam pinout and package standard
- Single 1.8V power supply (Vcc): 1.7V (min) to 1.9V (max)
- Dedicated output supply voltage (Vccq): 1.8V or 1.5V typical
- LVC MOS-compatible I/O interface
- Common data I/O pins (DQs)
- Single Data Rate (SDR) data transfers
- Late Write Flow Through read operations
- Burst and non-burst read and write operations, selectable via dedicated control pin (ADV)
- Internally controlled Linear Burst address sequencing during burst operations
- Full read/write coherency
- Byte write capability
- Single cycle deselect
- Single-ended input clock (CLK)
- Selectable output driver impedance via dedicated control pin (ZQ)
- Depth expansion capability (2 or 4 banks) via programmable chip enables (E2, E3, EP2, EP3)
- JTAG boundary scan (subset of IEEE standard 1149.1)
- 209 Ball (11x19), 1mm pitch, 14mm x 22mm Ball Grid Array (BGA) package



Bottom View

209-Ball, 14 mm x 22 mm BGA  
1 mm Ball Pitch, 11 x 19 Ball Array

### SIGMARAM FAMILY OVERVIEW

The IS61FSCS series  $\Sigma$ RAMs are built in compliance with the SigmaRAM pinout standard for synchronous SRAMs. The implementations are 18,874,368-bit (18Mb) SRAMs. These are the first in a family of wide, very low voltage CMOS I/O SRAMs designed to operate at the speeds needed to implement economical high performance networking systems.

ISSI's  $\Sigma$ RAMs are offered in a number of configurations that emulate other synchronous SRAMs, such as Burst RAMs, NBT RAMs, Late Write, or Double Data Rate (DDR) SRAMs. The logical differences between the protocols employed by these RAMs hinge mainly on various combinations of address bursting, output data registering and write cueing.  $\Sigma$ RAMs allow a user to implement the interface protocol best suited to the task at hand.

This specific product is Common I/O, SDR, Flow Through and in the family is identified as 1x1Lf.

## FUNCTIONAL DESCRIPTION

Because SigmaRAM is a synchronous device, address, data inputs, and read/write control inputs are captured on the rising edge of the input clock. Write cycles are internally self-timed and initiated by the rising edge of the clock input. This feature eliminates complex off-chip write pulse generation required by asynchronous SRAMs and simplifies input signal timing.

IS61FSCS series  $\Sigma$ RAMs are implemented with ISSI's high performance CMOS technology and are packaged in a 209-Ball BGA.

## IS61NSCS25672 PINOUT

### 256K x 72 COMMON I/O—TOP VIEW

	1	2	3	4	5	6	7	8	9	10	11
A	DQg	DQg	A	E2	A (16M)	ADV	A (8M)	E3	A	DQb	DQb
B	DQg	DQg	$\overline{Bc}$	$\overline{Bg}$	NC	$\overline{W}$	A	$\overline{Bb}$	$\overline{Bf}$	DQb	DQb
C	DQg	DQg	$\overline{Bh}$	$\overline{Bd}$	NC (128M)	$\overline{E1}$	NC	$\overline{Be}$	$\overline{Ba}$	DQb	DQb
D	DQg	DQg	GND	NC	NC	MCL	NC	NC	GND	DQb	DQb
E	DQPg	DQPc	Vccq	Vccq	Vcc	Vcc	Vcc	Vccq	Vccq	DQPf	DQPb
F	DQc	DQc	GND	GND	GND	ZQ	GND	GND	GND	DQf	DQf
G	DQc	DQc	Vccq	Vccq	Vcc	EP2	Vcc	Vccq	Vccq	DQf	DQf
H	DQc	DQc	GND	GND	GND	EP3	GND	GND	GND	DQf	DQf
J	DQc	DQc	Vccq	Vccq	Vcc	M4	Vcc	Vccq	Vccq	DQf	DQf
K	NC	NC	CLK	NC	GND	MCL	GND	NC	NC	NC	NC
L	DQh	DQh	Vccq	Vccq	VCC	M2	Vcc	Vccq	Vccq	DQa	DQa
M	DQh	DQh	GND	GND	GND	M3	GND	GND	GND	DQa	DQa
N	DQh	DQh	Vccq	Vccq	VCC	MCH	Vcc	Vccq	Vccq	DQa	DQa
P	DQh	DQh	GND	GND	GND	MCL	GND	GND	GND	DQa	DQa
R	DQPd	DQPh	Vccq	Vccq	Vcc	Vcc	Vcc	Vccq	Vccq	DQPa	DQPe
T	DQd	DQd	GND	NC	NC	MCL	NC	NC	GND	DQe	DQe
U	DQd	DQd	NC	A	NC (64M)	A	NC (32M)	A	NC	DQe	DQe
V	DQd	DQd	A	A	A	A1	A	A	A	DQe	DQe
W	DQd	DQd	TMS	TDI	A	A0	A	TDO	TCK	DQe	DQe

IS61NSCS51236 PINOUT

512K X 36 COMMON I/O—TOP VIEW

	1	2	3	4	5	6	7	8	9	10	11
A	NC	NC	A	E2	A (16M)	ADV	A	E3	A	DQb	DQb
B	NC	NC	$\overline{Bc}$	NC	A (x36)	$\overline{W}$	A	$\overline{Bb}$	NC	DQb	DQb
C	NC	NC	NC	$\overline{Bd}$	NC (128M)	$\overline{E1}$	NC	NC	$\overline{Ba}$	DQb	DQb
D	NC	NC	GND	NC	NC	MCL	NC	NC	GND	DQb	DQb
E	NC	DQPc	Vccq	Vccq	Vcc	Vcc	Vcc	Vccq	Vccq	NC	DQPb
F	DQc	DQc	GND	GND	GND	ZQ	GND	GND	GND	NC	NC
G	DQc	DQc	Vccq	Vccq	Vcc	EP2	Vcc	Vccq	Vccq	NC	NC
H	DQc	DQc	GND	GND	GND	EP3	GND	GND	GND	NC	NC
J	DQc	DQc	Vccq	Vccq	Vcc	M4	Vcc	Vccq	Vccq	NC	NC
K	NC	NC	CLK	NC	GND	MCL	GND	NC	NC	NC	NC
L	NC	NC	Vccq	Vccq	Vcc	M2	Vcc	Vccq	Vccq	DQa	DQa
M	NC	NC	GND	GND	GND	M3	GND	GND	GND	DQa	DQa
N	NC	NC	Vccq	Vccq	Vcc	MCH	Vcc	Vccq	Vccq	DQa	DQa
P	NC	NC	GND	GND	GND	MCL	GND	GND	GND	DQa	DQa
R	DQPd	NC	Vccq	Vccq	Vcc	Vcc	Vcc	Vccq	Vccq	DQPa	NC
T	DQd	DQd	GND	NC	NC	MCL	NC	NC	GND	NC	NC
U	DQd	DQd	NC	A	NC (64M)	A	NC (32M)	A	NC	NC	NC
V	DQd	DQd	A	A	A	A1	A	A	A	NC	NC
W	DQd	DQd	TMS	TDI	A	A0	A	TDO	TCK	NC	NC

11 x 19 Ball BGA—14 x 22 mm<sup>2</sup> Body—1 mm Ball Pitch

## PIN DESCRIPTION TABLE

Symbol	Pin Location	Description	Type	Comments
A	A3, A5, A7, A9, B7, U4, U6, U8, V3, V4, V5, V6, V7, V8, V9, W5, W6, W7	Address	Input	—
A	B5	Address	Input	x36 version
ADV	A6	Advance	Input	Active High
$\overline{Bx}$	B3, C9	Byte Write Enable	Input	Active Low (all versions)
$\overline{Bx}$	B8, C4	Byte Write Enable	Input	Active Low (x36 and x72 versions)
$\overline{Bx}$	B4, B9, C3, C8	Byte Write Enable	Input	Active Low (x72 version only)
CK	K3	Clock	Input	Active High
DQ	E2, F1, F2, G1, G2, H1, H2, J1, J2, L10, L11, M10, M11, N10, N11, P10, P11, R10 A10, A11, B10, B11, C10, C11, D10, D11, E11, R1, T1, T2, U1, U2, V1, V2, W1, W2	Data I/O	Input/Output	x36, and x72 versions
		Data I/O	Input/Output	
DQ	A1, A2, B1, B2, C1, C2, D1, D2, E1, E10, F10, F11, G10, G11, H10, H11, J10, J11, L1, L2, M1, M2, N1, N2, P1, P2, R2, R11, T10, T11, U10, U11, V10, V11, W10, W11	Data I/O	Input/Output	x72 version only
$\overline{E1}$	C6	Chip Enable	Input	Active Low
E2 & E3	A4, A8	Chip Enable	Input	Programmable Active High or Low
EP2 & EP3	G6, H6	Chip Enable Program Pin	Input	—
TCK	W9	Test Clock	Input	Active High
TDI	W4	Test Data In	Input	—
TDO	W8	Test Data Out	Output	—
TMS	W3	Test Mode Select	Input	—
M2, M3 & M4	L6, M6, J6	Mode Control Pins	Input	Must tie to Low, Low, and High
MCL	D6, K6, P6, T6	Must Connect Low	Input	—
MCH	N6	Must Connect high	Input	—

## PIN DESCRIPTION TABLE

Symbol	Pin Location	Description	Type	Comments
NC	C5, D4, D5, D7, D8, K4, K8, K9, T4, T5, T7, T8, U3, U5, U7, U9	No Connect	—	Not connected to die (all versions)
NC	B5	No Connect	—	Not connected to die (x72 version)
NC	C7	No Connect	—	Not connected to die (x72/x36 versions)
NC	A1, A2, B1, B2, B4, B9, C1, C2, C3, C8, D1, D2, E1, E10, F10, F11, G10, G11, H10, H11, J10, J11, L1, L2, M1, M2, N1, N2, P1, P2, R2, R11, T10, T11, U10, U11, V10, V11, W10, W11	No Connect	—	Not connected to die (x36 version)
$\overline{W}$	B6	Write	Input	Active Low
V <sub>CC</sub>	E5, E6, E7, G5, G7, J5, J7, L5, L7, N5, N7, R5, R6, R7	Core Power Supply	Input	1.8 V Nominal
V <sub>CCQ</sub>	E3, E4, E8, E9, G3, G4, G8, G9, J3, J4, J8, J9 L3, L4, L8, L9, N3, N4 N8, N9, R3, R4, R8, R9	Output Driver Power Supply	Input	1.8 V or 1.5 V Nominal
GND	D3, D9, F3, F4, F5, F7, F8, F9, H3, H4, H5, H7, H8, H9, K5, K7, M3, M4, M5, M7, M8, M9, P3, P4, P5, P7, P8, P9, T3, T9	Ground	Input	—
ZQ	F6	Output Impedance Control	Input	Low = Low Impedance [High Drive] High = High Impedance [Low Drive] Default = High

BACKGROUND

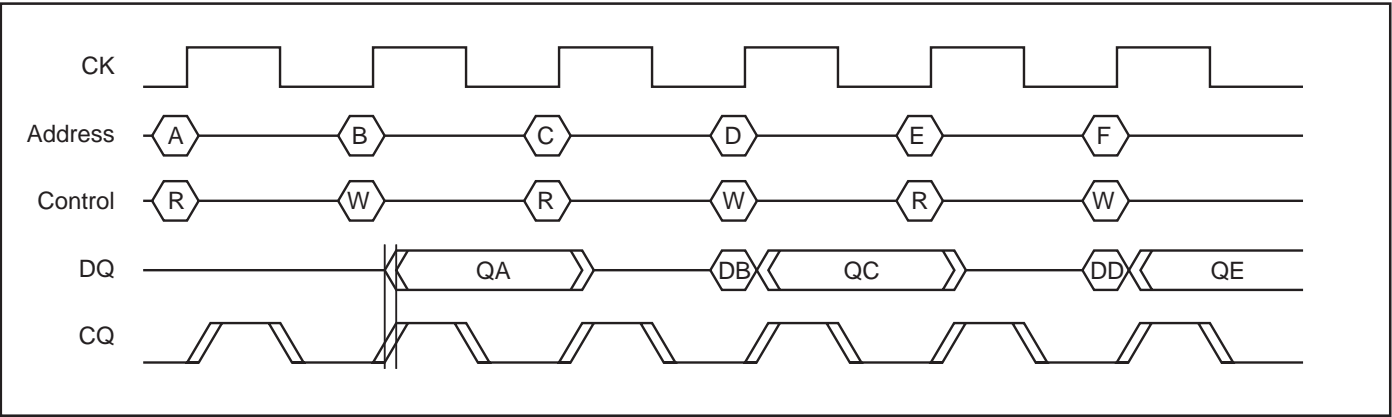
The central characteristics of the ISSI  $\Sigma$ RAMs are that they are extremely fast and consume little power. Because both operating and interface power is low,  $\Sigma$ RAMs can be implemented in a wide (x72) configuration, providing very high single package bandwidth (in excess of 20 Gb/s in ordinary pipelined configuration) and very low random access time (~6 ns). The use of very low voltage circuits in the core and 1.8V or 1.5V interface voltages allow the speed, power and density performance of  $\Sigma$ RAMs.

Although the SigmaRAM family pinouts have been designed to support a number of different common read and write protocol options, not all SigmaRAM implementations will support all possible protocols. The following timing diagrams provide a quick comparison between read and write protocols options available in the context of the

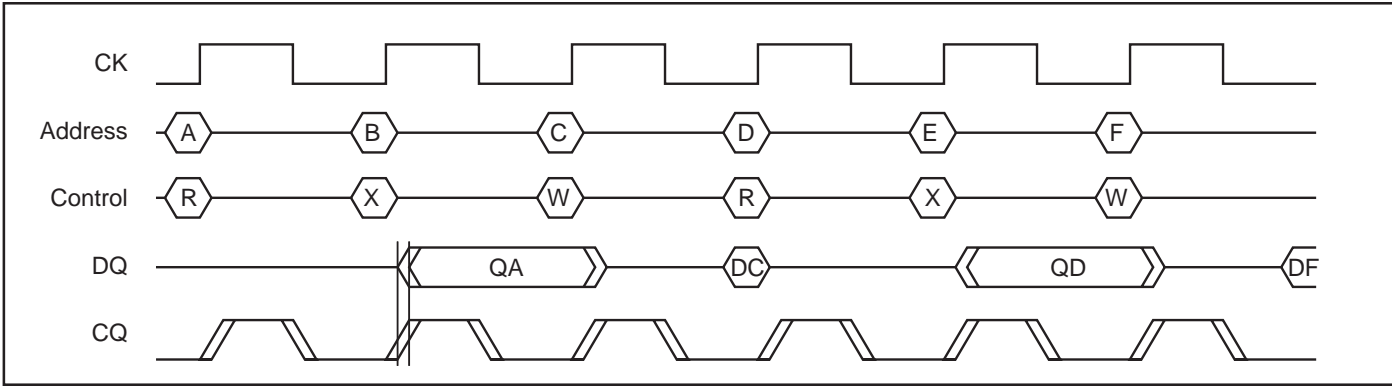
SigmaRAM standard. This data sheet covers the single data rate (non-DDR), Flow Through Read SigmaRAM.

The character of the applications for fast synchronous SRAMs in networking systems are extremely diverse.  $\Sigma$ RAMs have been developed to address the diverse needs of the networking market in a manner that can be supported with a unified development and manufacturing infrastructure.  $\Sigma$ RAMs address each of the bus protocol options commonly found in networking systems. This allows the  $\Sigma$ RAM to find application in radical shrinks and speed-ups of existing networking chip sets that were designed for use with older SRAMs, like the NBT and Late Write, or Double Data Rate SRAMs, as well as with new chip sets and ASIC's that employ the Echo Clocks and realize the full potential of the  $\Sigma$ RAMs.

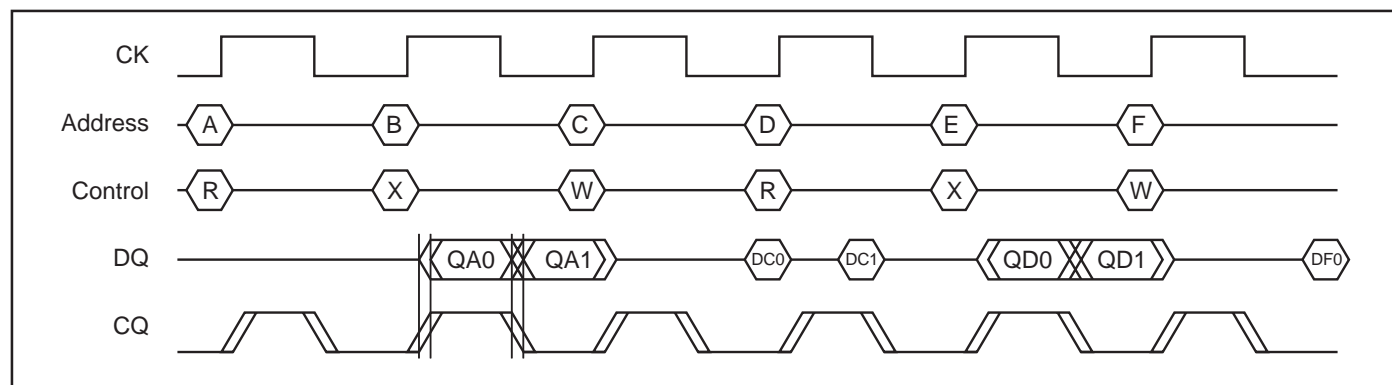
COMMON I/O SigmaRAM FAMILY MODE COMPARISON—LATE WRITE VS. DOUBLE LATE WRITE  
DOUBLE LATE WRITE—PIPELINED READ ( $\Sigma 1 \times 1 \text{Dp}$ ). For reference only.



LATE WRITE—PIPELINED READ ( $\Sigma 1 \times 1 \text{Lp}$ ). For reference only.



**DOUBLE DATA RATE WRITE—DOUBLE DATA RATE READ ( $\Sigma 1x2Lp$ ). For reference only.**



## READ OPERATIONS

### Flow through Read

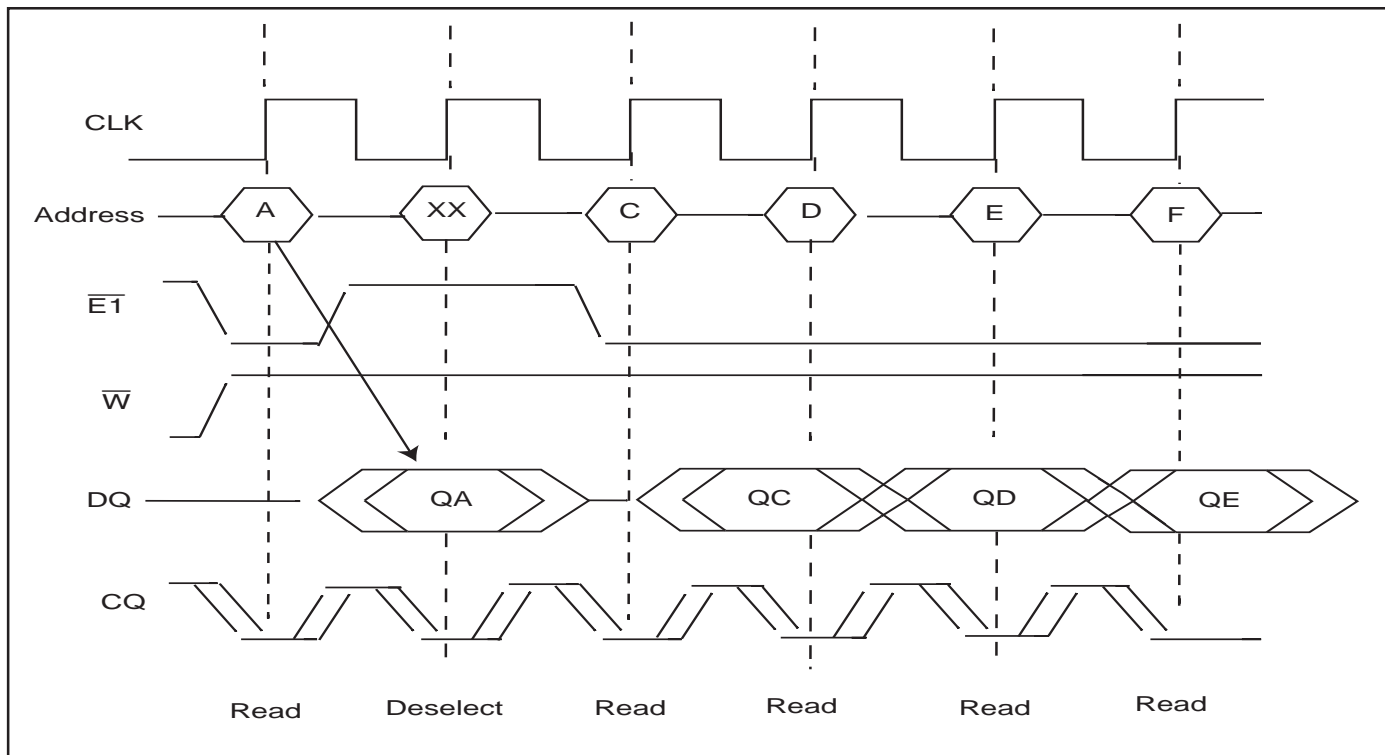
Read operation is initiated when the following conditions are satisfied at the rising edge of clock: All three chip enables ( $\overline{E1}$ , E2, and E3) are active, the write enable input signal ( $\overline{W}$ ) is deasserted high, and ADV is asserted low. The address presented to the address inputs is latched into the address register and presented to the memory core and control logic. The control logic determines that a read access is in progress and allows the requested data to propagate to output.

## WRITE OPERATIONS

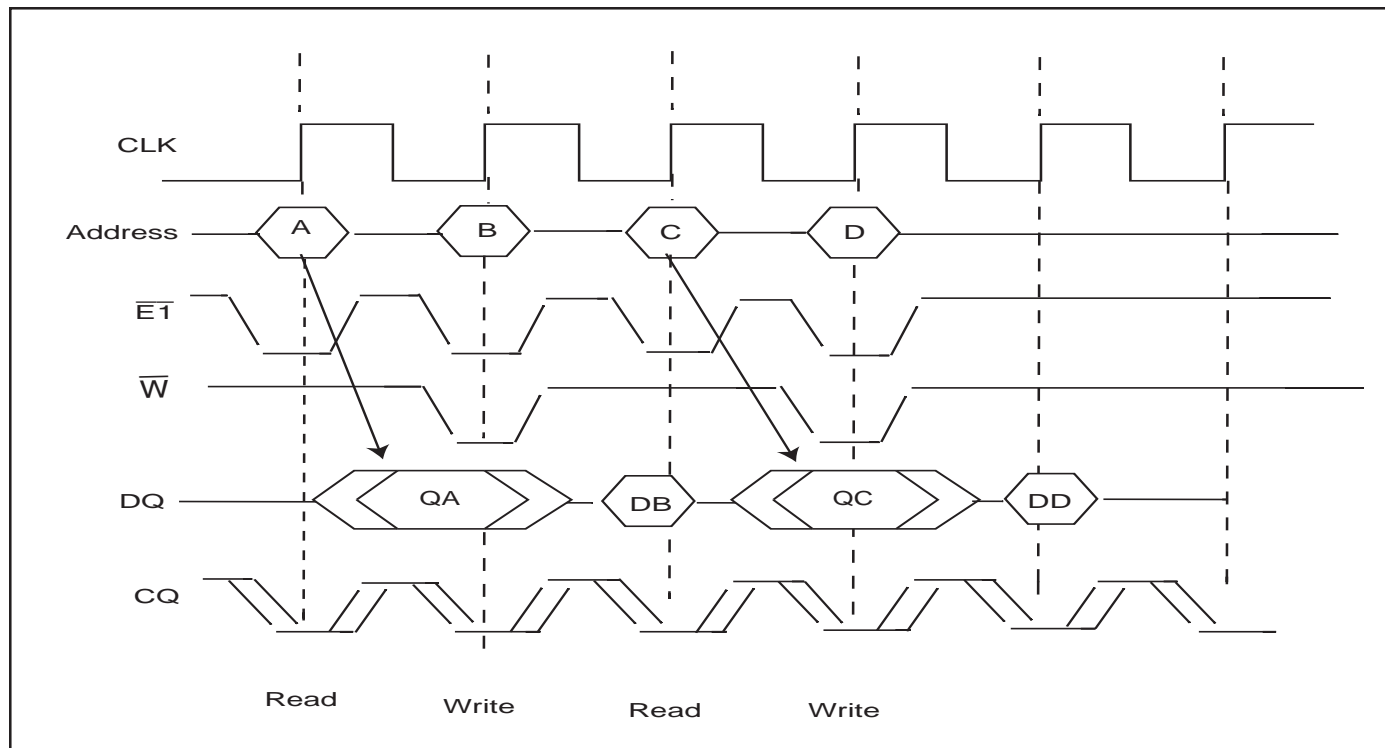
Write operation occurs when the following conditions are satisfied at the rising edge of clock: All three chip enables ( $\overline{E1}$ , E2, and E3) are active and the write enable input signal ( $\overline{W}$ ) is asserted low.

Data is taken at next rising edge, as a Late Write.

## SINGLE DATA RATE FLOW THROUGH READ



## FLOW THROUGH WRITE AND READ





# SPECIAL FUNCTIONS

## Burst Cycles

$\Sigma$ RAMs provide an on-chip burst address generator that can be utilized, if desired, to further simplify burst read or write implementations. The ADV control pin, when driven high, commands the  $\Sigma$ RAM to advance the internal address counter and use the counter generated address to read or write the  $\Sigma$ RAM. The starting address for the first cycle in a burst cycle series is loaded into the  $\Sigma$ RAM by driving the ADV pin low, into Load mode.

## Burst Order

The burst address counter wraps around to its initial state after four addresses (the loaded address and three more) have been accessed. SigmaRAMs always count in linear burst order.

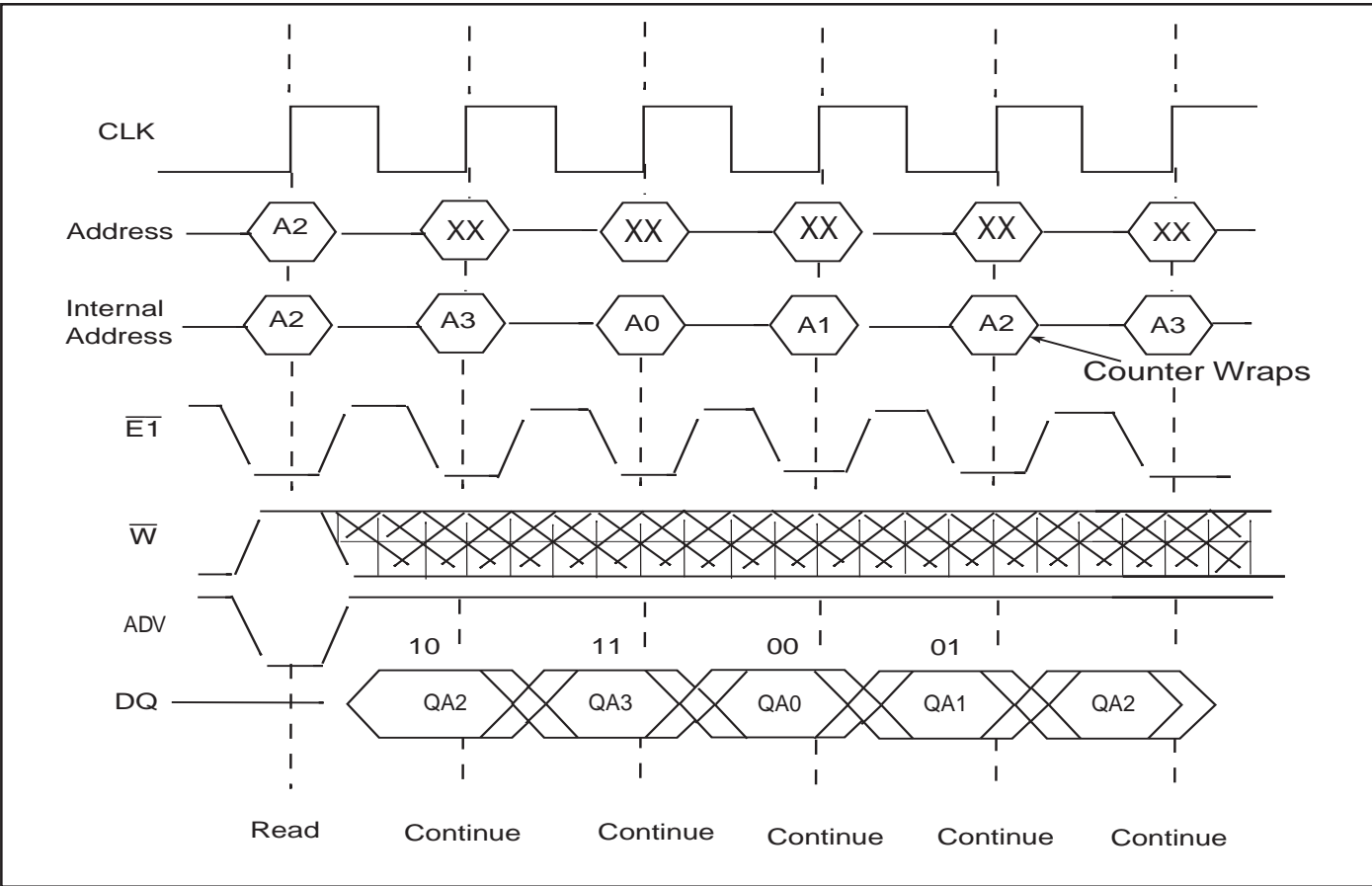
## Linear Burst Order

	A[1:0]	A[1:0]	A[1:0]	A[1:0]
1st address	00	01	10	11
2nd address	01	10	11	00
3rd address	10	11	00	01
4th address	11	00	01	10

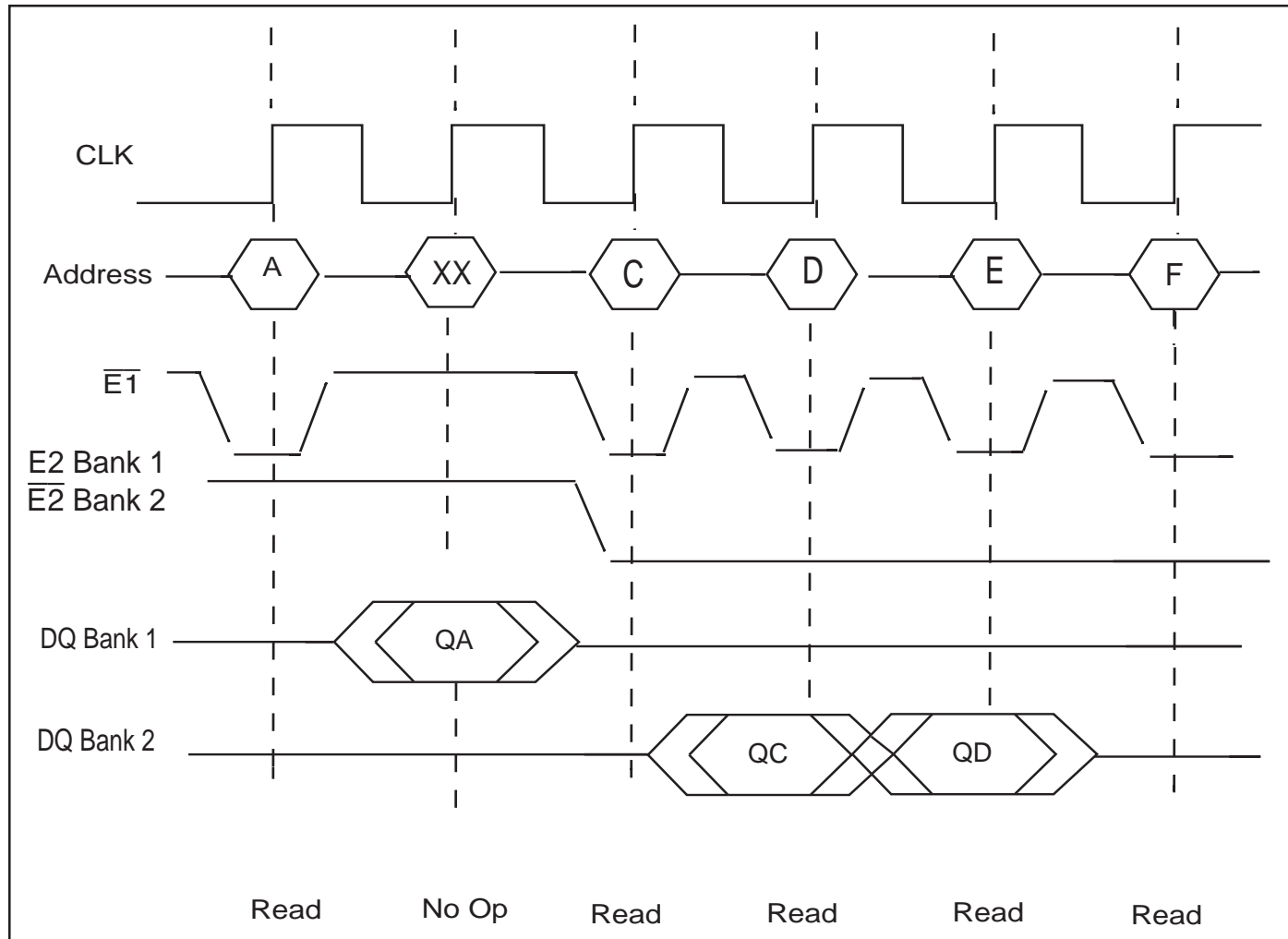
Note:

1. The burst counter wraps to initial state on the 5th rising edge of clock.

# SIGMA FLOW THROUGH BURST READS WITH COUNTER WRAP-AROUND



## FLOW THROUGH READ BANK SWITCH WITH E1 DESELECT



Note:  
E1 does not deselect the Echo Clock Outputs. Echo Clock outputs are synchronously deselected by E2 or E3 being sampled false.

## OUTPUT DRIVER IMPEDANCE CONTROL

SigmaRAMs may be supplied with either selectable (high) impedance output drivers. The ZQ pin of SigmaRAMs supplied with selectable impedance drivers, allows selection between  $\Sigma$ RAM nominal drive strength (ZQ low) for multi-drop bus applications and low drive strength (ZQ floating or high) point-to-point applications. The impedance of the data and clock output drivers in these devices can be controlled via the static input ZQ. When ZQ is tied "low", output driver impedance is set to  $\sim 25\ \Omega$ . When ZQ is tied "high" or left unconnected, output driver impedance is set to  $\sim 50\ \Omega$ . See the DC Electrical Characteristics section for further information. The SRAM requires 32K cycles of power-up time after  $V_{CC}$  reaches its operating range.

## OUTPUT DRIVER CHARACTERISTICS - TBD

## PROGRAMMABLE ENABLES

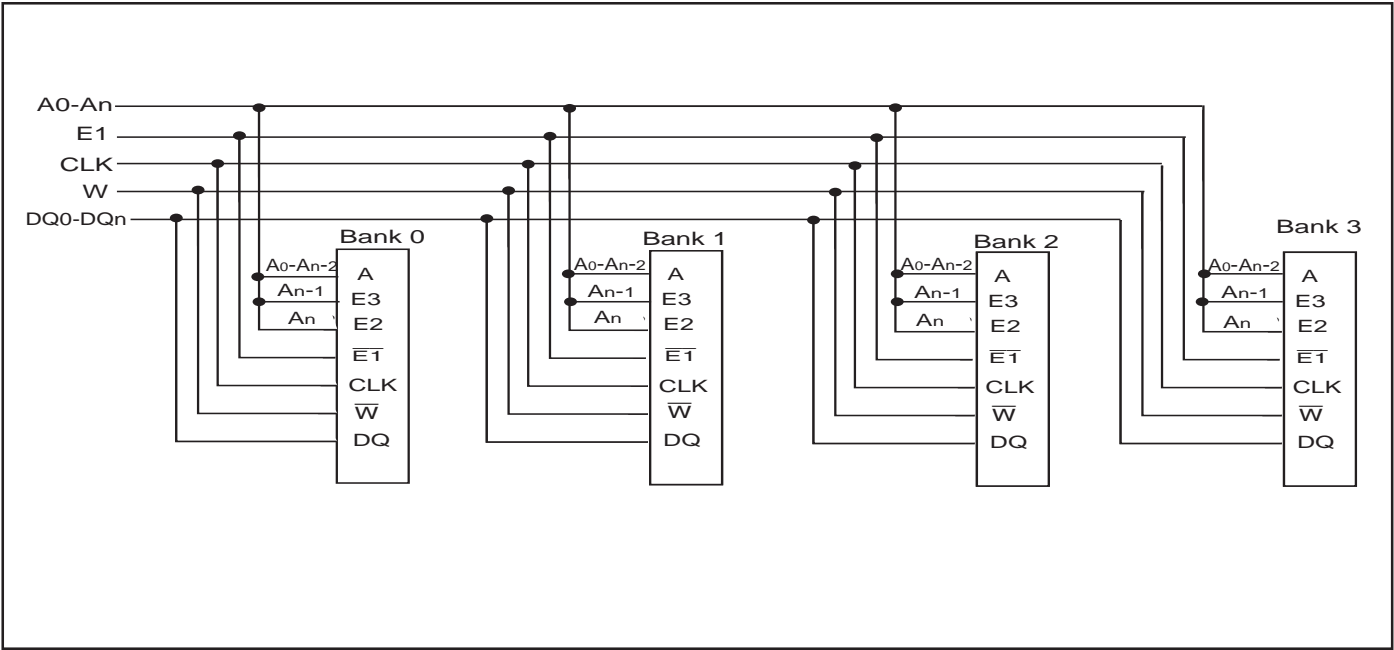
SRAMs feature two user-programmable chip enable inputs, E2 and E3. The sense of the inputs, whether they function as active low or active high inputs, is determined by the state of the programming inputs, EP2 and EP3. For example, if EP2 is held at Vcc, E2 functions as an active high enable. If EP2 is held to GND, E2 functions as an active low chip enable input.

Programmability of E2 and E3 allows four banks of depth expansion to be accomplished with no additional logic. By programming the enable inputs of four SRAMs in binary sequence (00, 01, 10, 11) and driving the enable inputs with two address inputs, four SRAMs can be made to look like one larger RAM to the system.

## BANK ENABLE TRUTH TABLE

	EP2	EP3	E2	E3
Bank 0	GND	GND	Active Low	Active Low
Bank 1	GND	Vcc	Active Low	Active High
Bank 2	Vcc	GND	Active High	Active Low
Bank 3	Vcc	Vcc	Active High	Active High

## EXAMPLE FOUR BANK DEPTH EXPANSION SCHEMATIC



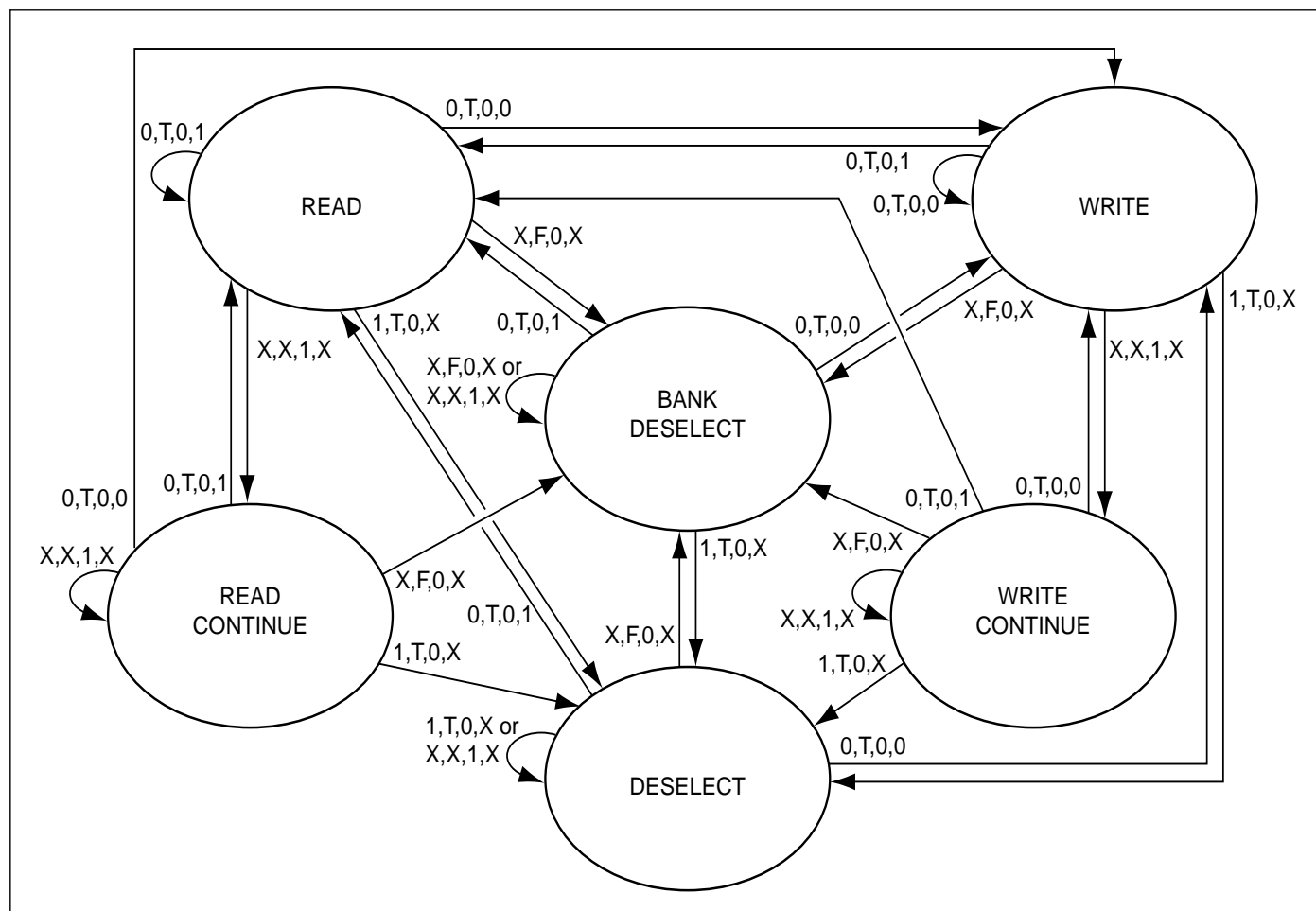
## SYNCHRONOUS TRUTH TABLE

CLK	$\overline{E}1$ (tn)	E (tn)	ADV (tn)	W (tn)	BW (tn)	Previous Operation	Current Operation	DQ (tn)	DQ (tn+1)
0→1	X	F	0	X	X	X	Bank Deselect	***	Hi-Z
0→1	X	X	1	X	X	Bank Deselect	Bank Deselect (Continue)	Hi-Z	Hi-Z
0→1	1	T	0	X	X	X	Deselect	***	Hi-Z
0→1	X	X	1	X	X	Deselect	Deselect (Continue)	Hi-Z	Hi-Z
0→1	0	T	0	0	T	X	Write Loads new address Stores DQx if $\overline{BW}x = 0$	***	Dn (tn)
0→1	0	T	0	0	F	X	Write (Abort) Loads new address No data stored	***	Hi-Z
0→1	X	X	1	X	T	Write	Write Continue Increments address by 1 Stores DQx if $\overline{BW}x = 0$	Dn-1 (tn-1)	Dn (tn)
0→1	X	X	1	X	F	Write	Write Continue (Abort) Increments address by 1 No data stored	Dn-1 (tn-1)	Hi-Z
0→1	0	T	0	1	X	X	Read Loads new address	***	Qn (tn)
0→1	X	X	1	X	X	Read	Read Continue Increments address by 1	Qn-1 (tn-1)	Qn (tn)

### Notes:

1. If  $E2 = EP2$  and  $E3 = EP3$  then  $E = "T"$  else  $E = "F"$ .
2. If one or more  $\overline{BW}x = 0$  then  $BW = "T"$  else  $BW = "F"$ .
3. "1" = input "high"; "0" = input "low"; "X" = input "don't care"; "T" = input "true"; "F" = input "false".
4. "\*\*\*" indicates that the DQ input requirement/output state are determined by the previous operation.
5. DQs are tri-stated in response to Bank Deselect, Deselect, and Write commands, one full cycle after the command is sampled.
6. Up to 3 Continue operations may be initiated after initiating a Read or Write operation to burst transfer up to 4 distinct pieces of data per single external address input. If a fourth (4th) Continue operation is initiated, the internal address wraps back to the initial external (base) address.

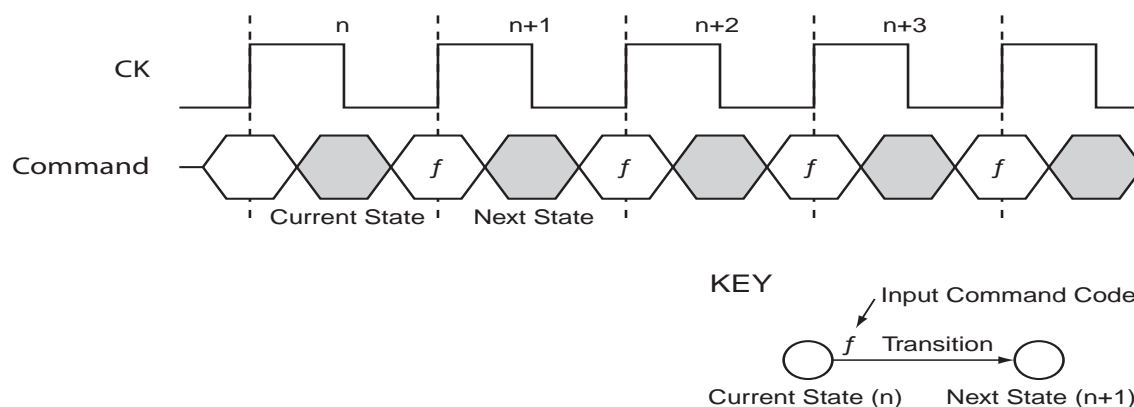
## READ/WRITE CONTROL STATE DIAGRAM



### Notes:

1. The notation "X,X,X,X" controlling the state transitions above indicate the states of inputs  $\overline{E1}$ , E, ADV, and  $\overline{W}$  respectively.
2. If (E2 = EP2 and E3 = EP3) then E = "T" else E = "F".
3. "1" = input "high"; "0" = input "low"; "X" = input "don't care"; "T" = input "true"; "F" = input "false".

## CURRENT STATE & NEXT STATE DEFINITION FOR READ/WRITE CONTROL STATE DIAGRAM



## ABSOLUTE MAXIMUM RATINGS

(All voltages reference to GND )

Symbol	Description	Value	Unit
V <sub>CC</sub>	Voltage on V <sub>CC</sub> Pins	-0.5 to 2.5	V
V <sub>CCQ</sub>	Voltage in V <sub>CCQ</sub> Pins	-0.5 to 2.3V	V
V <sub>I/O</sub>	Voltage on I/O Pins	-0.5 to V <sub>CCQ</sub> +0.5 (≤ 2.3 V max.)	V
V <sub>IN</sub>	Voltage on Other Input Pins	-0.5 to V <sub>CCQ</sub> +0.5 (≤ 2.3 V max.)	V
I <sub>IN</sub>	Input Current on Any Pin	±100	mA dc
I <sub>OUT</sub>	Output Current on Any Pin	±100	mA dc
T <sub>J</sub>	Maximum Junction Temperature	125	°C
T <sub>STG</sub>	Storage Temperature	-55 to 125	°C

Note:

Permanent device damage may occur if Absolute Maximum Ratings are exceeded. Operation should be limited to Recommended Operating Conditions. Exposure to conditions exceeding Recommended Operating Conditions, for an extended period of time, may affect reliability of this component.

## POWER SUPPLY CHARACTERISTICS (T<sub>A</sub> = 0 min., 25 typ, 70 max °C)

Symbol	Parameter	Min.	Typ.	Max.	Unit
V <sub>CC</sub>	Supply Voltage	1.7	1.8	1.9	V
V <sub>CCQ</sub> <sup>(1)</sup>	1.8 V I/O Supply Voltage	1.7	1.8	V <sub>CC</sub>	V
	1.5 V I/O Supply Voltage	1.4	1.5	1.6 V	V

Note:

1. Unless otherwise noted, all performance specifications quoted are evaluated for worst case at both 1.4 V ≤ V<sub>CCQ</sub> ≤ 1.6V (i.e., 1.5 V I/O) and 1.7 V ≤ V<sub>CCQ</sub> ≤ 1.9 V (i.e., 1.8 V I/O) and quoted at whichever condition is worst case.

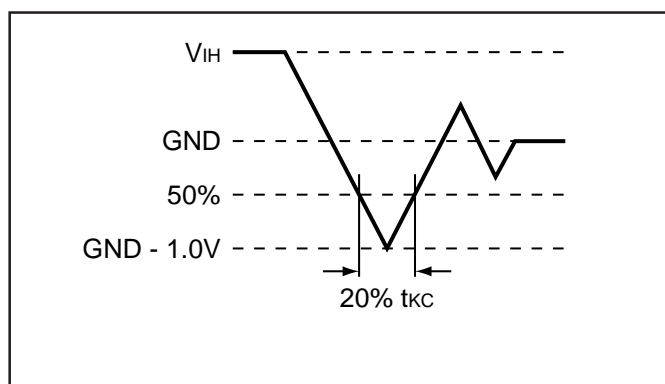
## CMOS I/O DC INPUT CHARACTERISTICS

Symbol	Parameter	V <sub>CCQ</sub>	Min.	Typ.	Max.	Unit
V <sub>IH</sub>	CMOS Input High Voltage	1.8	1.2	—	V <sub>CCQ</sub> + 0.3	V
		1.5	1.0	—	V <sub>CCQ</sub> + 0.3	
V <sub>IL</sub>	CMOS Input Low Voltage	1.8	−0.3	—	0.6	V
		1.5	−0.3	—	0.5	

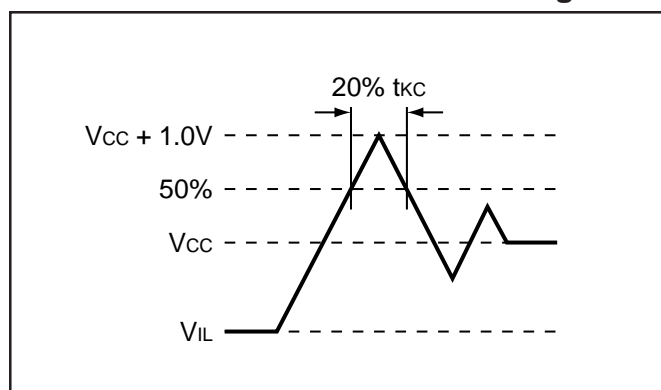
Note:

For devices supplied with CMOS input buffers. Compatible with both 1.8 V and 1.5 V I/O drivers.

## Undershoot Measurement and Timing



## Overshoot Measurement and Timing



## I/O CAPACITANCE (T<sub>A</sub> = 25 °C, f = 1 MHz)

Symbol	Parameter	Test conditions	Min.	Max.	Unit
C <sub>A</sub>	Address	Input Capacitance	V <sub>IN</sub> = 0 V	—	3.5 pF
C <sub>B</sub>	Control	Input Capacitance	V <sub>IN</sub> = 0 V	—	3.5 pF
C <sub>CK</sub>	Clock	Input Capacitance	V <sub>IN</sub> = 0 V	—	3.5 pF
C <sub>DQ</sub>	Data	Output Capacitance	V <sub>OUT</sub> = 0 V	—	4.5 pF

Note: These parameters are sampled and not 100% tested.

## AC TEST CONDITIONS

( $V_{CC} = 1.8V \pm 0.1V$ ,  $T_A = 0$  to  $85^\circ C$ )

Parameter	Symbol	Conditions		Units
$V_{CCQ}$		$1.5V \pm 0.1$	$1.8 \pm 0.1$	V
Input High Level	$V_{IH}$	1.25	1.4	V
Input Low Level	$V_{IL}$	0.25	0.4	V
Input Rise & Fall Time		2.0	2.0	V/ns
Input Reference Level		0.75	0.9	V
Clock Input High Voltage	$V_{KIH}$	1.25	1.4	V
Clock Input Low Voltage	$V_{KIL}$	0.25	0.4	V
Clock Input Rise & Fall Time		2.0	2.0	V/ns
Clock Input Reference Level		0.75	0.9	V
Output Reference Level		0.75	0.9	V
Output Load Conditions $Z_Q = V_{IH}$		see below	see below	

### Notes:

1. Include scope and jig capacitance.
2. Test conditions as specified with output loading as shown unless otherwise noted.

## AC TEST LOADS

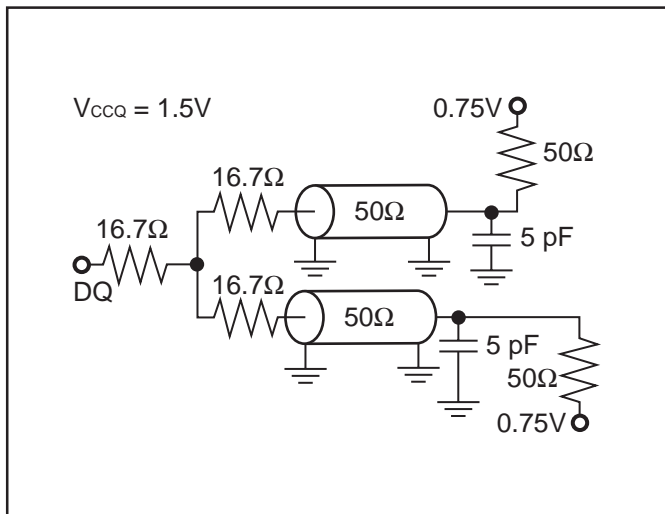


Figure 1 ( $V_{CCQ} = 1.5V$ )

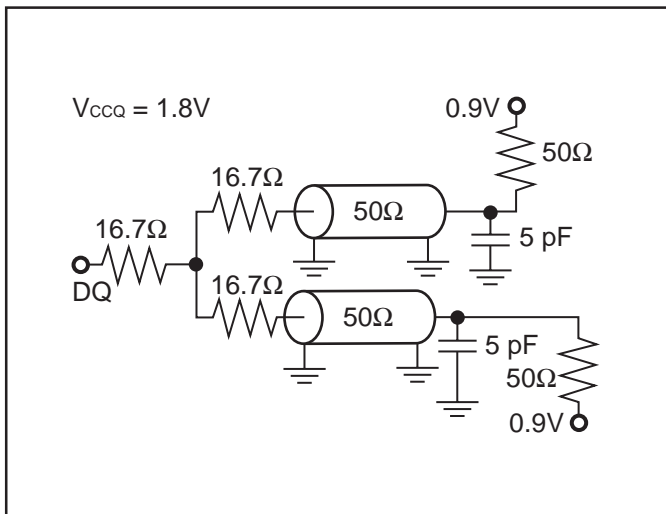


Figure 2 ( $V_{CCQ} = 1.8V$ )



## SELECTABLE IMPEDANCE OUTPUT DRIVER DC ELECTRICAL CHARACTERISTICS

Symbol	Parameter	Test Conditions	Min.	Max.	Units
$V_{OHL}^{(1)}$	Low Drive Output High Voltage	$I_{OHL} = -4 \text{ mA}$	$V_{CCQ} - 0.4$	—	V
$V_{OLL}^{(1)}$	Low Drive Output Low Voltage	$I_{OLL} = 4 \text{ mA}$	—	0.4	V
$V_{OHH}^{(2)}$	High Drive Output High Voltage	$I_{OHH} = -8 \text{ mA}$	$V_{CCQ} - 0.4$	—	V
$V_{OLH}^{(2)}$	High Drive Output Low Voltage	$I_{OLH} = 8 \text{ mA}$	—	0.4	V

Notes:

1. ZQ = 1; High Impedance output driver setting

2. ZQ = 0; Low Impedance output driver setting

## OUTPUT RESISTANCE

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
$R_{OUT}$	Output Resistance	$V_{OH}, V_{OL} = V_{CCQ}/2$ $ZQ = V_{IL}$	17	25	33	$\Omega$
		$V_{OH}, V_{OL} = V_{CCQ}/2$ $ZQ = V_{IH}$	35	50	65	$\Omega$

## OPERATING CURRENTS

Symbol	Parameter	Test Conditions		-7.2		-7.5		Units
				Com.	Ind.	Com.	Ind.	
$I_{CC}$	Operating Current	$E1 \leq V_{IL} \text{ Max.}$ $t_{KHKH} \geq t_{KHKH} \text{ Min.}$ All other inputs $V_{IL} \geq V_{IN} \geq V_{IH}$	Pipeline x72 x36	600	600	600	600	mA
$I_{SB1}$ & $I_{SB2}$	Bank Deselect Current & Chip Disable Current	$E1 \leq V_{IH} \text{ Min. or}$ $E2 \text{ or } E3 \text{ False}$ $t_{KHKH} \geq t_{KHKH} \text{ Min.}$ All other inputs $V_{IL} \geq V_{IN} \geq V_{IH}$	Pipeline x72 x36	250	250	250	250	mA
$I_{SB3}$	CMOS Deselect Current	Device Deselected All inputs $GND+0.10V \geq V_{IN} \geq V_{CC}-0.10V$	Pipeline x72 x36	150	150	150	150	mA

Note: Com. = 0°C to 70°C  
Ind. = -40°C to +85°C

## OPERATING CURRENTS (continued)

Symbol	Parameter	Test Conditions	-8.0		-8.5		-9.0		Units
			Com.	Ind.	Com.	Ind.	Com.	Ind.	
I <sub>CC</sub>	Operating Current	E1 ≤ V <sub>IL</sub> Max. t <sub>KHKH</sub> ≥ t <sub>KHKH</sub> Min. All other inputs V <sub>IL</sub> ≥ V <sub>IN</sub> ≥ V <sub>IH</sub>		Pipeline x72 x36	500 350	500 350	500 350		mA
ISB1 & ISB2	Bank Deselect Current & Chip Disable Current	E1 ≤ V <sub>IH</sub> Min. or E2 or E3 False t <sub>KHKH</sub> ≥ t <sub>KHKH</sub> Min. All other inputs V <sub>IL</sub> ≥ V <sub>IN</sub> ≥ V <sub>IH</sub>		Pipeline x72 x36	250 225	250 350	250 225		mA
ISB3	CMOS Deselect Current	Device Deselected All inputs GND+0.10V ≥ V <sub>IN</sub> ≥ V <sub>CC</sub> -0.10V		Pipeline x72 x36	150 150	150 150	150 150		mA

Note: Com. = 0°C to 70°C  
Ind. = -40°C to +85°C

## DC ELECTRICAL CHARACTERISTICS

(V<sub>CC</sub> = 1.8V ±0.1V, GND = 0V, T<sub>A</sub> = 0° to 85°C)

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
I <sub>LI</sub>	Input Leakage Current (Address, Control, Clock)	V <sub>IN</sub> = GND to V <sub>CCQ</sub>	-5	—	5	uA
I <sub>MLI</sub>	Input Leakage Current (EP2, EP3, M2, M3, M4, ZQ)	V <sub>MIN</sub> = GND to V <sub>CC</sub>	-10	—	10	uA
I <sub>DLI</sub>	Input Leakage Current (Data)	V <sub>DIN</sub> = GND to V <sub>CCQ</sub>	-10	—	10	uA

## AC ELECTRICAL CHARACTERISTICS

Symbol	Parameter	-7.2		-7.5		-8		Unit
		Min	Max	Min	Max	Min	Max	
t <sub>KHKH</sub>	Clock Cycle Time	7.2	—	7.5	—	8.0	—	ns
t <sub>KHKL</sub>	Clock HIGH Time	2.8	—	3.0	—	3.2	—	ns
t <sub>CLKH</sub>	Clock LOW Time	2.8	—	3.0	—	3.2	—	ns
t <sub>KHQX1</sub> <sup>(1)</sup>	Clock High to Output in Low-Z	0.5	—	0.5	—	0.5	—	ns
t <sub>KHQV</sub>	Clock High to Output Valid	—	5.0	—	5.5	—	6.7	ns
t <sub>KHQX</sub>	Clock High to Output Invalid	1.0	—	1.0	—	1.0	—	ns
t <sub>KHQZ</sub> <sup>(1)</sup>	Clock High to Output in High-Z	1.0	5.0	1.0	5.5	1.0	6.7	ns
t <sub>AVKH</sub>	Address Valid to Clock High	0.6	—	0.7	—	0.8	—	ns
t <sub>KHAX</sub>	Clock High to Address Don't Care	0.4	—	0.4	—	0.5	—	ns
t <sub>EVKH</sub>	Enable Valid to Clock High	0.6	—	0.7	—	0.8	—	ns
t <sub>KHEX</sub>	Clock High to Enable Don't Care	0.4	—	0.4	—	0.5	—	ns
t <sub>WVKH</sub>	Write Valid to Clock High	0.6	—	0.7	—	0.8	—	ns
t <sub>KHWX</sub>	Clock High to Write Don't Care	0.4	—	0.4	—	0.5	—	ns
t <sub>BVKH</sub>	Byte Write Valid to Clock High	0.6	—	0.7	—	0.8	—	ns
t <sub>KHBX</sub>	Clock High to Byte Write Don't Care	0.4	—	0.4	—	0.5	—	ns
t <sub>DVKH</sub>	Data In Valid to Clock High	0.6	—	0.7	—	0.8	—	ns
t <sub>KHDX</sub>	Clock High to Data In Don't Care	0.4	—	0.4	—	0.5	—	ns
t <sub>advVKH</sub>	ADV Valid to Clock High	0.6	—	0.7	—	0.8	—	ns
t <sub>KHadvX</sub>	Clock High to ADV Don't Care	0.4	—	0.4	—	0.5	—	ns

### Notes:

1. Measured at 100 mV from steady state. Not 100% tested.
2. Guaranteed by design. Not 100% tested.
3. For any specific temperature and voltage t<sub>KHCZ</sub> < t<sub>KHCX1</sub>.

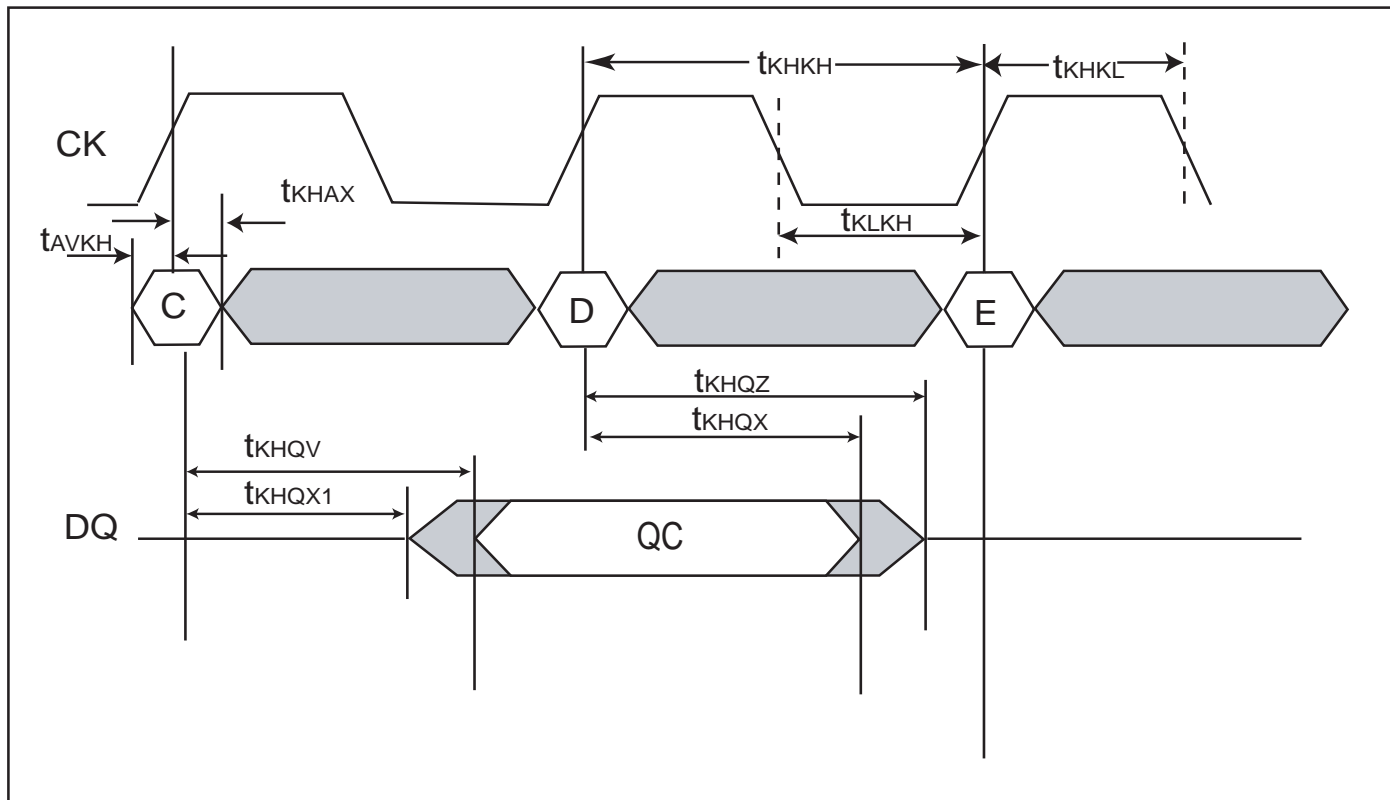
## AC ELECTRICAL CHARACTERISTICS

Symbol	Parameter	-8.5		-9		Unit
		Min	Max	Min	Max	
t <sub>KHKH</sub>	Clock Cycle Time	8.5	—	9.0	—	ns
t <sub>KHKL</sub>	Clock HIGH Time	3.4	—	3.6	—	ns
t <sub>KLKH</sub>	Clock LOW Time	3.4	—	3.6	—	ns
t <sub>KHQX1</sub> <sup>(1)</sup>	Clock High to Output in Low-Z	0.5	—	0.5	—	ns
t <sub>KHQV</sub>	Clock High to Output Valid	—	7.2	—	7.5	ns
t <sub>KHQX</sub>	Clock High to Output Invalid	1.0	—	1.0	—	ns
t <sub>KHQZ</sub> <sup>(1)</sup>	Clock High to Output in High-Z	—	7.2	—	7.5	ns
t <sub>AVKH</sub>	Address Valid to Clock High	1.1	—	1.5	—	ns
t <sub>KHAX</sub>	Clock High to Address Don't Care	0.5	—	0.5	—	ns
t <sub>EVKH</sub>	Enable Valid to Clock High	1.1	—	1.5	—	ns
t <sub>KHEX</sub>	Clock High to Enable Don't Care	0.5	—	0.5	—	ns
t <sub>WVKH</sub>	Write Valid to Clock High	1.1	—	1.5	—	ns
t <sub>KHWX</sub>	Clock High to Write Don't Care	0.5	—	0.5	—	ns
t <sub>BVKH</sub>	Byte Write Valid to Clock High	1.1	—	1.5	—	ns
t <sub>KHBX</sub>	Clock High to Byte Write Don't Care	0.5	—	0.5	—	ns
t <sub>DVKH</sub>	Data In Valid to Clock High	1.1	—	1.5	—	ns
t <sub>KHDX</sub>	Clock High to Data In Don't Care	0.5	—	0.5	—	ns
t <sub>advVKH</sub>	ADV Valid to Clock High	1.1	—	1.5	—	ns
t <sub>KHadvX</sub>	Clock High to ADV Don't Care	0.5	—	0.5	—	ns

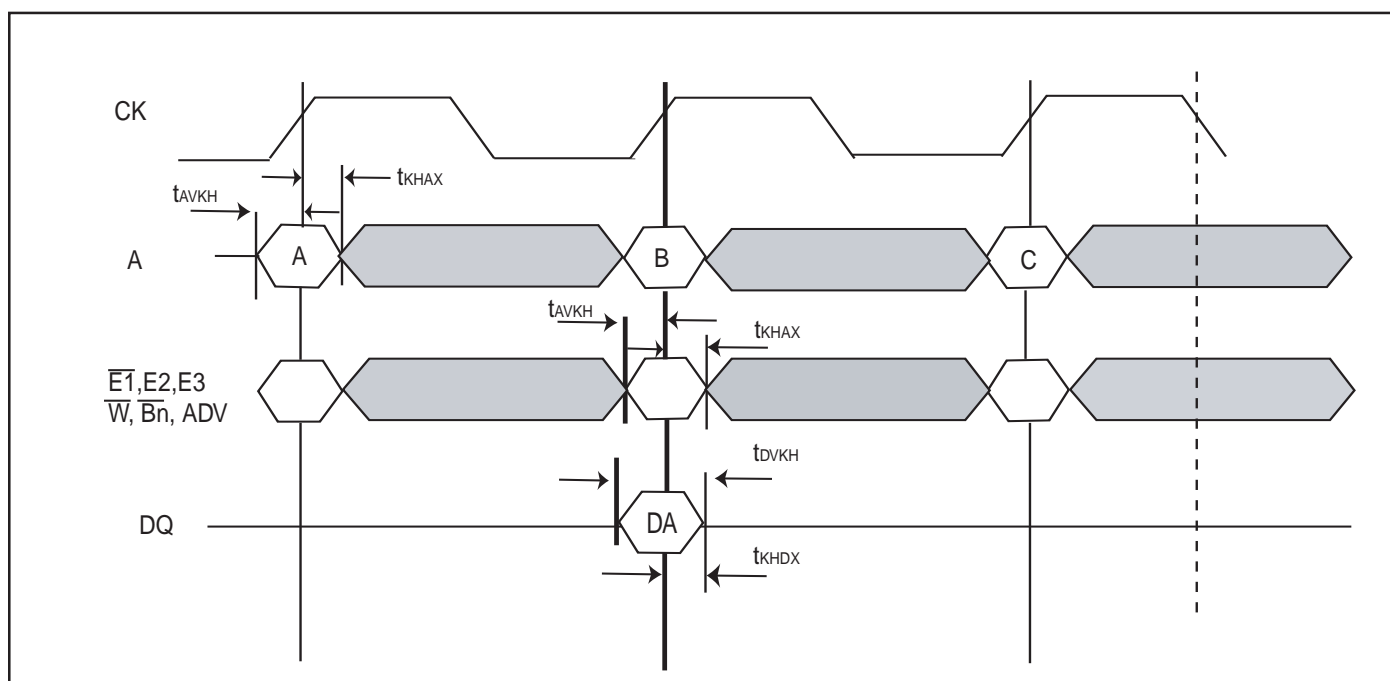
### Notes:

1. Measured at 100 mV from steady state. Not 100% tested.
2. Guaranteed by design. Not 100% tested.
3. For any specific temperature and voltage t<sub>KHCZ</sub> < t<sub>KHCX1</sub>.

# TIMING PARAMETER KEY—FLOW THROUGH READ CYCLE TIMING



# TIMING PARAMETER KEY—WRITE MODE CONTROL AND DATA IN TIMING



Note:  $t_{nvKH} = t_{vKH}$ ,  $t_{wvKH}$ ,  $t_{bvKH}$ , etc. and  $t_{KHX} = t_{KHEx}$ ,  $t_{KHwX}$ ,  $t_{KHbX}$ , etc.

## JTAG PORT OPERATION

### Overview

These devices provide a JTAG Test Access Port (TAP) and Boundary Scan interface using a limited set of IEEE std. 1149.1 functions. This test mode is intended to provide a mechanism for testing the interconnect between master (processor, controller, etc.), SRAMs, other components, and the printed circuit board.

In conformance with a subset of IEEE std. 1149.1, these devices contain a TAP Controller and four TAP Registers. The TAP Registers consist of one Instruction Register and

three Data Registers (ID, Bypass, and Boundary Scan Registers).

### Disabling the JTAG Port

It is possible to use this device without utilizing the JTAG port. The port is reset at power-up and will remain inactive unless clocked. To assure normal operation of the RAM with the JTAG Port unused, TCK should be tied Low, TDI and TMS may be left floating or tied to V<sub>CC</sub>. TDO should be left unconnected.

## JTAG PIN DESCRIPTIONS

Pin	Pin Name	I/O	Description
TCK	Test Clock	In	Clocks all TAP events. All inputs are captured on the rising edge of TCK and all outputs propagate from the falling edge of TCK.
TMS	Test Mode Select	In	The TMS input is sampled on the rising edge of TCK. This is the command input for the TAP controller. An undriven TMS input will produce the same result as a logic one input level.
TDI	Test Data In	In	The TDI input is sampled on the rising edge of TCK. This is the input side of the serial registers placed between TDI and TDO. The register placed between TDI and TDO is determined by the state of the TAP Controller and the instruction that is currently loaded in the TAP Instruction Register (refer to the TAP Controller State Diagram). An undriven TDI pin will produce the same result as a logic one input level.
TDO	Test Data Out	Out	Output that is active depending on the state of the TAP Controller. Output changes in response to the falling edge of TCK. This is the output side of the serial registers placed between TDI and TDO.

#### Note:

This device does not have a TRST (TAP Reset) pin. TRST is optional in IEEE 1149.1. The Test-Logic-Reset state is entered while TMS is held high for five rising edges of TCK. The TAP Controller is also reset automatically at power-up.

## JTAG PORT REGISTERS

### Overview

The JTAG registers, referred to as Test Access Port (TAP) registers, are selected (one at a time) via the sequences of 1s and 0s applied to TMS as TCK is strobed. Each of the TAP registers are serial shift registers that capture serial input data on the rising edge of TCK and push serial data out on the next falling edge of TCK. When a register is selected, it is placed between the TDI and TDO pins.

### Instruction Register

The Instruction Register holds the instructions that are executed by the TAP controller when it is moved into the Run, Test/Idle, or the various data register states. Instructions are 3 bits long. The Instruction Register can be loaded when it is placed between the TDI and TDO pins. The Instruction Register is automatically preloaded with the IDCODE instruction at power-up or whenever the controller is placed in Test-Logic-Reset state.

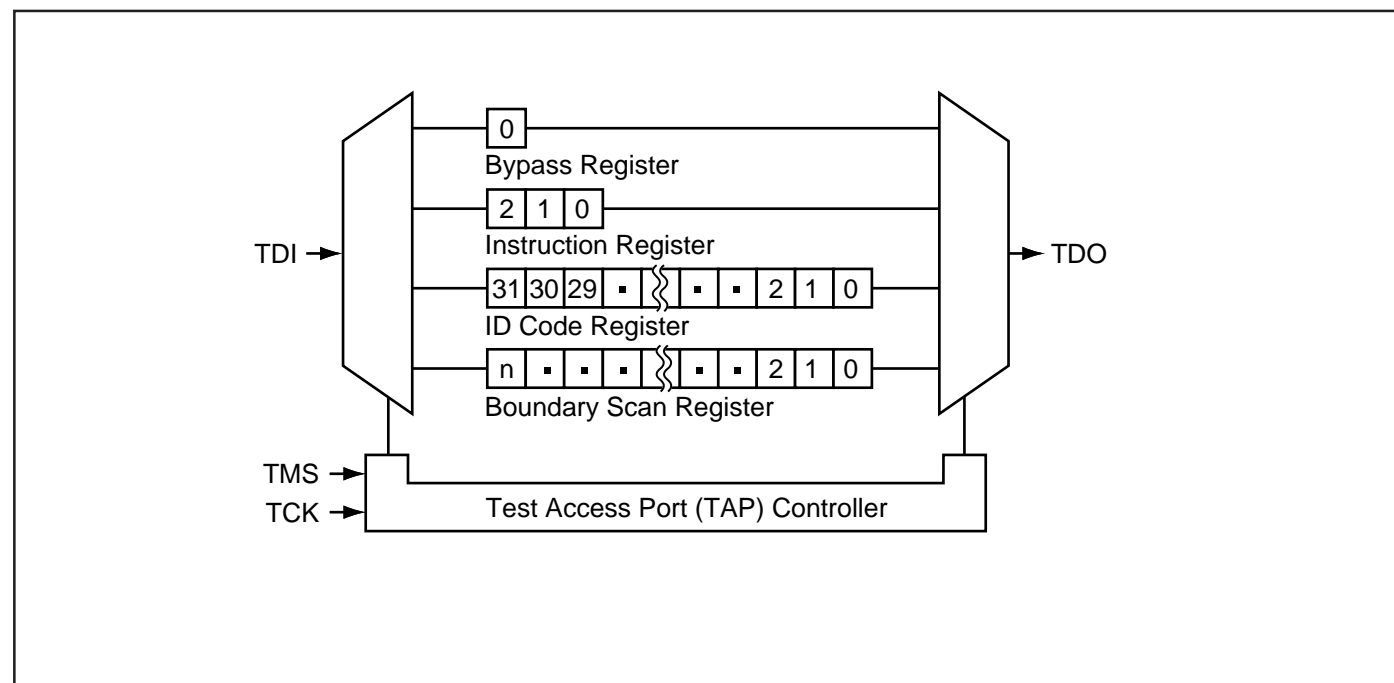
### Bypass Register

The Bypass Register is a single-bit register that can be placed between TDI and TDO. It allows serial test data to be passed through the RAM's JTAG Port to another device in the scan chain with as little delay as possible.

### Boundary Scan Register

The Boundary Scan Register is a collection of flip flops that can be preset by the logic level found on the RAM's input or I/O pins. The flip flops are then daisy chained together so the levels found can be shifted serially out of the JTAG Port's TDO pin. The Boundary Scan Register also includes a number of place holder flip flops (always set to a logic 1). The relationship between the device pins and the bits in the Boundary Scan Register is described in the following Scan Order Table. The Boundary Scan Register, under the control of the TAP Controller, is loaded with the contents of the RAM's I/O ring when the controller is in Capture-DR state and then is placed between the TDI and TDO pins when the controller is moved to Shift-DR state. SAMPLE-Z, SAMPLE/PRELOAD and EXTEST instructions can be used to activate the Boundary Scan Register.

## JTAG TAP BLOCK DIAGRAM



IDENTIFICATION (ID) REGISTER

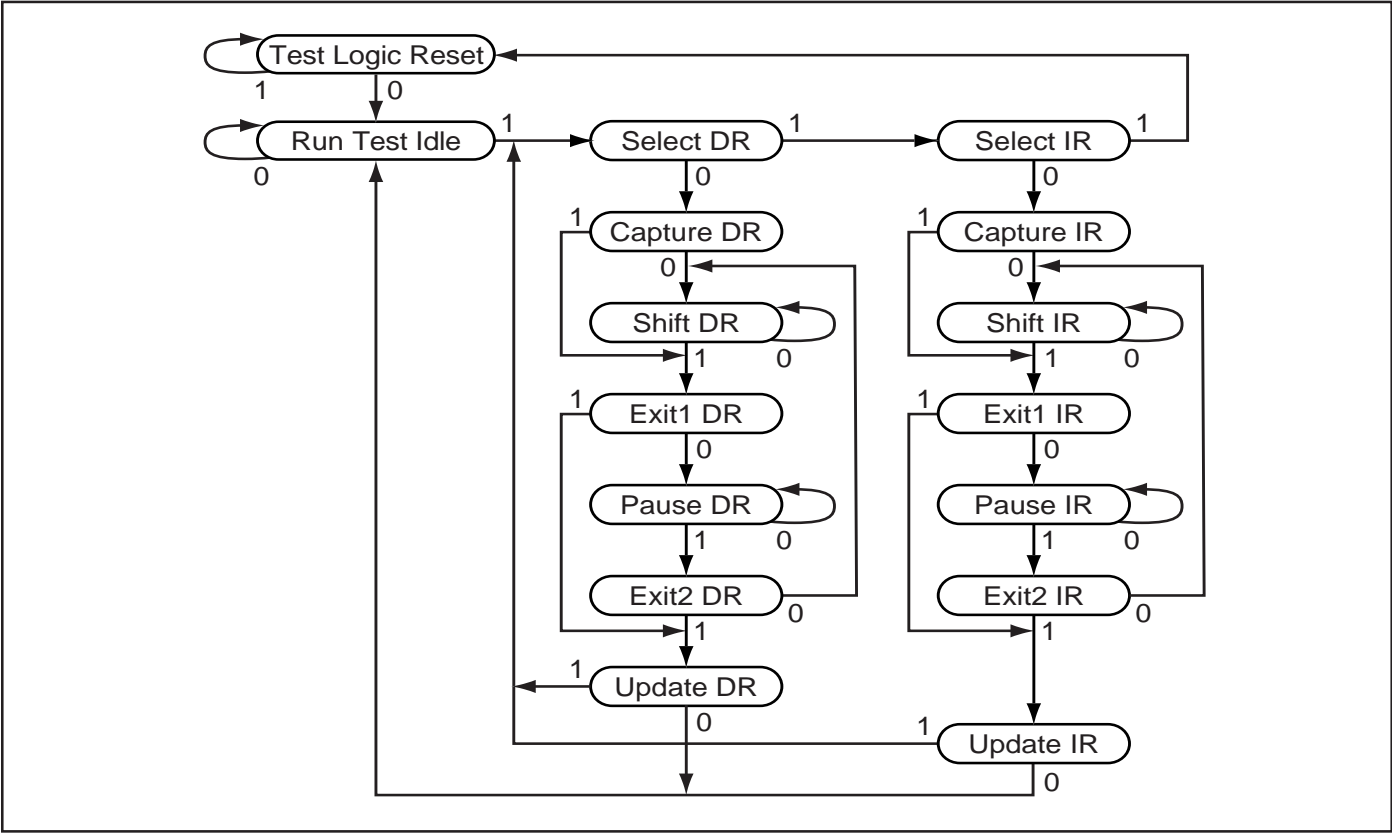
The ID Register is a 32-bit register that is loaded with a device and vendor specific 32-bit code when the controller is put in Capture-DR state with the IDCODE command loaded in the Instruction Register. The code is loaded from

a 32-bit on-chip ROM. It describes various attributes of the RAM as indicated below. The register is then placed between the TDI and TDO pins when the controller is moved into Shift-DR state. Bit 0 in the register is the LSB and the first to reach TDO when shifting begins.

ID REGISTER CONTENTS

	Die Revision Code				Not Used												I/O Configuration				ISSI Technology JEDEC Vendor ID Code												Presence Register
Bit #	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	
x72	X	X	X	X	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	1	1	0	1	0	1	0	1	1	
x36	X	X	X	X	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	1	0	1	0	1	0	1	1	

JTAG TAP CONTROLLER STATE DIAGRAM





## TAP CONTROLLER INSTRUCTION SET

### Overview

There are two classes of instructions defined in the Standard 1149.1-1990; standard (public) instructions, and device specific (private) instructions. Some public instructions are mandatory for 1149.1 compliance. Optional public instructions must be implemented in prescribed ways. The TAP on this device may be used to monitor all input and I/O pads. This device will not perform INTEST but can preform the preload portion of the SAMPLE/PRELOAD command.

When the TAP controller is placed in Capture-IR state, the two least significant bits of the instruction register are loaded with 001. When the controller is moved to the Shift-IR state, the Instruction Register is placed between TDI and TDO. In this state the desired instruction is serially loaded through the TDI input (while the previous contents are shifted out at TDO). For all instructions, the TAP executes newly loaded instructions only when the controller is moved to Update-IR state. The TAP instruction set for this device is listed in the JTAG TAP Instruction Set Summary.

## JTAG TAP INSTRUCTION SET SUMMARY

Instruction	Code	Description
EXTEST <sup>(1)</sup>	000	Places the Boundary Scan Register between TDI and TDO. When EXTEST is selected, data will be driven out of the DQ pad.
IDCODE <sup>(1,2)</sup>	001	Preloads ID Register and places it between TDI and TDO.
SAMPLE-Z <sup>(1)</sup>	010	Captures I/O ring contents. Places the Boundary Scan Register between TDI and TDO. Forces all Data and Clock output drivers to High-Z.
RFU <sup>(1)</sup>	011	Do not use this instruction; Reserved for Future Use. Replicates BYPASS instruction. Places Bypass Register between TDI and TDO.
SAMPLE/PRELOAD <sup>(1)</sup>	100	Captures I/O ring contents. Places the Boundary Scan Register between TDI and TDO.
Private <sup>(1)</sup>	101	Private instruction.
RFU <sup>(1)</sup>	110	Do not use this instruction; Reserved for Future Use.
BYPASS <sup>(1)</sup>	111	Places Bypass Register between TDI and TDO.

### Notes:

1. Instruction codes expressed in binary, MSB on left, LSB on right.
2. Default instruction automatically loaded at power-up and in Test-Logic-Reset state.

**JTAG DC RECOMMENDED OPERATING CONDITIONS** ( $T_A = 0$  to  $85^\circ\text{C}$ )

Symbol	Parameter	Test Conditions	Min.	Max.	Unit
$V_{TIH}$	JTAG Input High Voltage		1.2	$V_{CC} + 0.3$	V
$V_{TIL}$	JTAG Input Low Voltage		-0.3	0.6	V
$V_{TOH}$	JTAG Output High Voltage	CMOS TTL $I_{TOH} = -100\mu\text{A}$ $I_{TOH} = -8\text{mA}$	$V_{CC} - 0.1$ $V_{CC} - 0.4$	— —	V
$V_{TOL}$	JTAG Output Low Voltage	CMOS TTL $I_{TOL} = 100\mu\text{A}$ $I_{TOL} = 8\text{mA}$	— —	0.1 0.4	V
$I_{TLI}$	JTAG Input Leakage Current	$V_{TIN} = \text{GND to } V_{CC}$	-10	10	$\mu\text{A}$

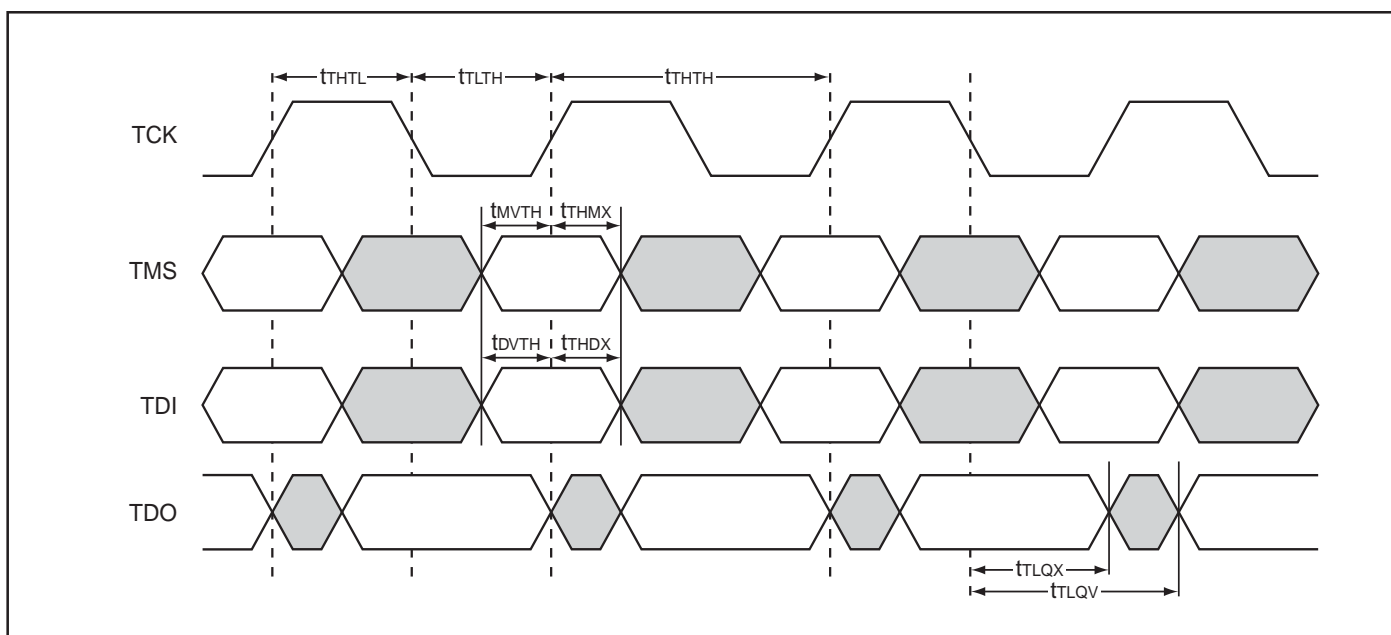
**JTAG AC TEST CONDITIONS** ( $V_{CC} = 1.8\text{V} \pm 0.1\text{V}$ ,  $T_A = 0$  to  $85^\circ\text{C}$ )

Symbol	Parameter	Test Conditions	Unit
$V_{TIH}$	JTAG Input High Voltage	1.6	V
$V_{TIL}$	JTAG Input Low Voltage	0.2	V
	JTAG Input Rise & Fall Time	1.0	V/ns
	JTAG Input Reference Level	0.9	V
	JTAG Output Reference Level	0.9	V
	JTAG Output Load Condition	see AC TEST LOADS	

## JTAG PORT AC ELECTRICAL CHARACTERISTICS

Symbol	Parameter	Min	Max	Unit
t <sub>HTH</sub>	TCK Cycle Time	20	—	ns
t <sub>HTL</sub>	TCK High Pulse Width	8	—	ns
t <sub>TLH</sub>	TCK Low Pulse Width	8	—	ns
t <sub>MVTH</sub>	TMS Setup Time	5	—	ns
t <sub>HMX</sub>	TMS Hold Time	5	—	ns
t <sub>DVTH</sub>	TDI Set Up Time	5	—	ns
t <sub>HDX</sub>	TDI Hold Time	5	—	ns
t <sub>TLQV</sub>	TCK Low to TDO Valid	—	10	ns
t <sub>TLQX</sub>	TCK Low to TDO Hold	0	—	ns

## JTAG PORT TIMING DIAGRAM



## INSTRUCTION DESCRIPTIONS

### BYPASS

When the BYPASS instruction is loaded to the Instruction Register, the Bypass Register is placed between TDI and TDO. This occurs when the TAP controller is moved to the Shift-DR state. This allows the board level scan path to be shortened to facilitate testing of other devices in the scan path.

### SAMPLE/PRELOAD

SAMPLE/PRELOAD is a Standard 1149.1 mandatory public instruction. When the SAMPLE/PRELOAD instruction is loaded in the Instruction Register, moving the TAP controller into the Capture-DR state loads the data in the RAMs input and I/O buffers into the Boundary Scan Register. Some Boundary Scan Register locations are not associated with an input or I/O pin, and are loaded with the default state identified in the BSDL file. Because the RAM clock is independent from the TAP Clock (TCK) it is possible for the TAP to attempt to capture the I/O ring contents while the input buffers are in transition (i.e. in a metastable state). Although allowing the TAP to sample metastable inputs will not harm the device, repeatable results cannot be expected. RAM input signals must be stabilized for long enough to meet the TAP's input data capture set-up plus hold time ( $t_{TS}$  plus  $t_{TH}$ ). The RAM's clock inputs need not be paused for any other TAP operation except capturing the I/O ring contents into the Boundary Scan Register. Moving the controller to Shift-DR state then places the Boundary Scan Register between the TDI and TDO pins.

### EXTEST

EXTEST is an IEEE 1149.1 mandatory public instruction. It is to be executed whenever the instruction register is loaded with all logic 0s. The EXTEST command does not block or override the RAM's input pins; therefore, the RAM's internal state is still determined by its input pins.

Typically, the Boundary Scan Register is loaded with the desired pattern of data with the SAMPLE/PRELOAD command. Then the EXTEST command is used to output the Boundary Scan Register's contents, in parallel, on the RAM's data output drivers on the falling edge of TCK when the controller is in the Update-IR state.

Alternately, the Boundary Scan Register may be loaded in parallel using the EXTEST command. When the EXTEST instruction is selected, the state of all the RAM's input and I/O pins, as well as the default values at Scan Register locations not associated with a pin (pin marked NC), are transferred in parallel into the Boundary Scan Register on the rising edge of TCK in the Capture-DR state. Boundary Scan Register contents may then be shifted serially through the register using the Shift-DR command or the controller can be skipped to the Update-DR command. When the controller is placed in the Update-DR state, a RAM that has fully compliant EXTEST function drives out the value of the Boundary Scan Register location associated with each output pin.

### IDCODE

The IDCODE instruction causes the ID ROM to be loaded to the ID register when the controller is in Capture-DR mode and places the ID register between the TDI and TDO pins in Shift-DR mode. The IDCODE instruction is the default instruction loaded in at power up and any time the controller is placed in the Test-Logic-Reset state.

### SAMPLE-Z

If the SAMPLE-Z instruction is loaded to the instruction register, all RAM outputs are forced to inactive state (high-Z) and the Boundary Scan Register is connected between TDI and TDO when the TAP controller is moved to the Shift-DR state.

### RFU

These instructions are reserved for future use. In this device they replicate the BYPASS instruction.

BOUNDARY SCAN ORDER ASSIGNMENTS (by Exit Sequence) PH =Place Holder

X72		Ball Loc.	X36	
Sequence	Pkg. Ball		Sequence	Pkg. Ball
1	A0	W6	1	A0
2	A	V7	2	A
3	A	V8	3	A
4	A	U8	4	A
5	A	V9	5	A
6	A	U6	6	A
7	PH <sup>(1)</sup>	U5	7	PH <sup>(1)</sup>
8	A	W7	8	A
9	PH <sup>(1)</sup>	U7	9	PH <sup>(1)</sup>
10	MCL	T6	10	MCL
11	M3	M6	11	M3
12	M4	J6	12	M4
13	MCL	K6	13	MCL
14	MCL	D6	14	MCL
15	PH <sup>(1)</sup>	C7	15	PH <sup>(1)</sup>
16	$\overline{B}e$	C8		
17	$\overline{B}a$	C9	16	$\overline{B}a$
18	$\overline{B}b$	B8	17	$\overline{B}b$
19	$\overline{B}f$	B9		
20	$\overline{W}$	B6	18	$\overline{W}$
21	ADV	A6	19	ADV
22	A	B7	20	A
23	E3	A8	21	E3
24	A	A9	22	A
25	ZQ	F6	23	ZQ
26	A	A3	24	A
27	E2	A4	25	E2
28	A	A5	26	A
29	A	A7	27	A
		B5	28	AO36
30	$\overline{B}c$	B3	29	$\overline{B}c$
31	$\overline{B}g$	B4		
32	$\overline{B}h$	C3		
33	$\overline{B}d$	C4	30	$\overline{B}d$
34	PH <sup>(1)</sup>	C5	31	PH <sup>(1)</sup>
35	$\overline{C}E1$	C6	32	$\overline{C}E1$
36	CP2	G6	33	CP2
37	CP3	H6	34	CP3
38	CK	K3	35	CK
39	M2	L6	36	M2

Note:

1. Input of PH register connected to Vss.

BOUNDARY SCAN ORDER ASSIGNMENTS (by Exit Sequence) Continued:

X72		Ball Loc.	X36	
Sequence	Pkg. Ball		Sequence	Pkg. Ball
40	NC	N6	37	NC
41	MCL	P6	38	MCL
42	A	V3	39	A
43	A	U4	40	A
44	A	V4	41	A
45	A	V5	42	A
46	A	W5	43	A
47	A1	V6	44	A1
48	DQd	W2	45	DQd
49	DQd	W1	46	DQd
50	DQd	V2	47	DQd
51	DQd	V1	48	DQd
52	DQd	U2	49	DQd
53	DQd	U1	50	DQd
54	DQd	T2	51	DQd
55	DQd	T1	52	DQd
56	DQPd	R1	53	DQPd
57	DQPh	R2		
58	DQh	P2		
59	DQh	P1		
60	DQh	N2		
61	DQh	N1		
62	DQh	M2		
63	DQh	M1		
64	DQh	L2		
65	DQh	L1		
66	NC	K2	54	NC
67	NC	K1	55	NC
68	DQc	J2	56	DQc
69	DQc	J1	57	DQc
70	DQc	H2	58	DQc
71	DQc	H1	59	DQc
72	DQc	G2	60	DQc
73	DQc	G1	61	DQc
74	DQc	F2	62	DQc
75	DQc	F1	63	DQc
76	DQPc	E2	64	DQPc
77	DQPg	E1		
78	DQg	D2		
79	DQg	D1		
80	DQg	C2		
81	DQg	C1		

**BOUNDARY SCAN ORDER ASSIGNMENTS (by Exit Sequence) Continued:**

X72		Ball Loc.	X36	
Sequence	Pkg. Ball		Sequence	Pkg. Ball
82	DQg	B2		
83	DQg	B1		
84	DQg	A2		
85	DQg	A1		
86	DQb	A10	65	DQb
87	DQb	A11	66	DQb
88	DQb	B10	67	DQb
89	DQb	B11	68	DQb
90	DQb	C10	69	DQb
91	DQb	C11	70	DQb
92	DQb	D10	71	DQb
93	DQb	D11	72	DQb
94	DQPb	E11	73	DQPb
95	DQPf	E10		
96	DQf	F10		
97	DQf	F11		
98	DQf	G10		
99	DQf	G11		
100	DQf	H10		
101	DQf	H11		
102	DQf	J10		
103	DQf	J11		
104	NC	K11	74	NC
105	NC	K10	75	NC
106	DQa	L10	76	DQa
107	DQa	L11	77	DQa
108	DQa	M10	78	DQa
109	DQa	M11	79	DQa
110	DQa	N10	80	DQa
111	DQa	N11	81	DQa
112	DQa	P10	82	DQa
113	DQa8	P11	83	DQa8
114	DQPa9	R10	84	DQPa9
115	DQPe1	R11		
116	DQe2	T10		
117	DQe3	T11		
118	DQe4	U10		
119	DQe5	U11		
120	DQe6	V10		
121	DQe7	V11		
122	DQe8	W10		
123	DQe9	W11		

## ORDERING INFORMATION

**Commercial Range: 0°C to 70°C**

	Cycle Time	Order Part No.	Package
256K x 72	9	IS61FSCS25672-9B	209-Ball BGA
	8.5	IS61FSCS25672-8.5B	209-Ball BGA
	8	IS61FSCS25672-8B	209-Ball BGA
	7.5	IS61FSCS25672-7.5B	209-Ball BGA
	7.2	IS61FSCS25672-7.2B	209-Ball BGA
512K x 36	9	IS61FSCS51236-9B	209-Ball BGA
	8.5	IS61FSCS51236-8.5B	209-Ball BGA
	8	IS61FSCS51236-8B	209-Ball BGA
	7.5	IS61FSCS51236-7.5B	209-Ball BGA
	7.2	IS61FSCS51236-7.2B	209-Ball BGA

**Industrial Range: -40°C to 85°C**

FrequencySpeed (ns)	Order Part No.	Package
TBD		