100 Pin TQFP
Commercial Temp
Industrial Temp

16Mb Pipelined and Flow through Synchronous NBT SRAM

200Mhz - 133Mhz
2.5V VDD
2.5V or 3.3V I/O

Features

User configurable Pipelined and Flow through mode.
NBT (No Bus Turn Around) functionality allows zero wait Read-Write-Read bus utilization. Fully pin compatible with both pipelined and flow through NtRAM , NoBL and ZBT SRAMs.
IEEE 1149.1 JTAG Compatible Boundary Scan.
On-Chip Write Parity Checking. Even or odd selectable.
2.5V +10%/-5% Core power supply
2.5V or 3.3V I/O supply.
3.3V Compatible Inputs.
LBO pin for linear or interleave burst mode.
Pin compatible with 2M, 4M and 8M devices.
Byte write operation. (9 bit Bytes).
3 chip enable signals for easy depth expansion.
Clock Control, registered, address, data, and control.
ZZ Pin for automatic power-down.
JEDEC standard 100-lead TQFP package.

		-200	-180	-166	-150	-133
Pipeline	tCycle	5ns	5.5ns	6ns	6.6ns	7.5ns
3-1-1-1	t_{KQ}	3.0ns	3.2ns	3.5ns	3.8ns	4.0ns
(x36)	I_{DD}	390mA	360mA	330mA	300mA	270mA
Flow Through	t_{KQ}	7.5ns	8ns	8.5ns	10ns	11ns
2-1-1-1	tCycle	10ns	10ns	10ns	10ns	15ns
(x36)	I_{DD}	275mA	275mA	275mA	275mA	195mA

Functional Description

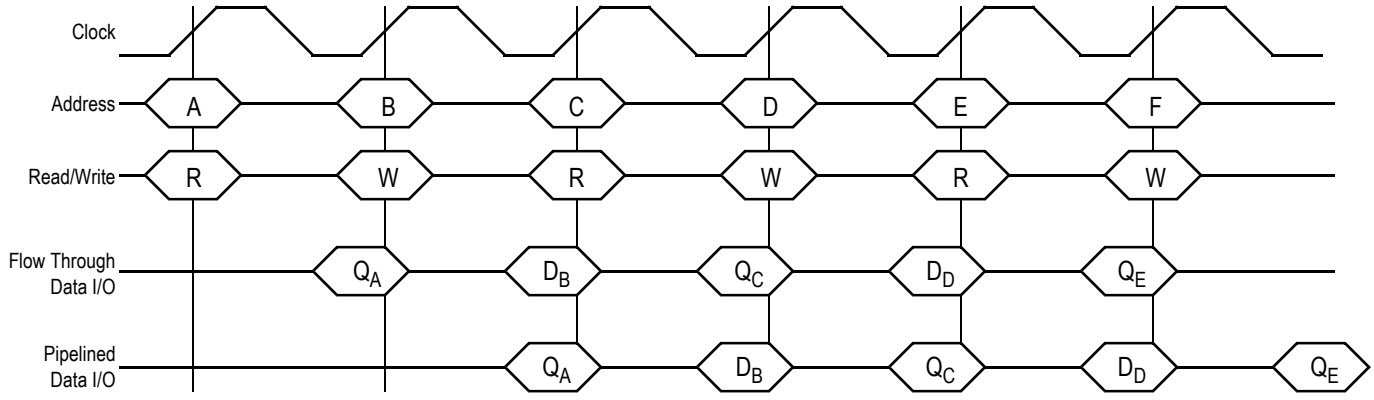
The GS8161Z18/36T is a 16M bit Synchronous Static SRAM. GSI's NBT SRAMs, like ZBT, NtRAM, NoBL or other pipelined read / double late write or flow through read / single late write SRAMs, allow utilization of all available bus bandwidth by eliminating the need to insert deselect cycles when the device is switched from read to write cycles.

Because it is a synchronous device, address, data inputs, and read/write control inputs are captured on the rising edge of the input clock. Burst order control (LBO) must be tied to a power rail for proper operation. Asynchronous inputs include the sleep mode enable, ZZ and Output Enable. Output Enable can be used to override the synchronous control of the output drivers and turn the RAM's output drivers off at any time. 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.

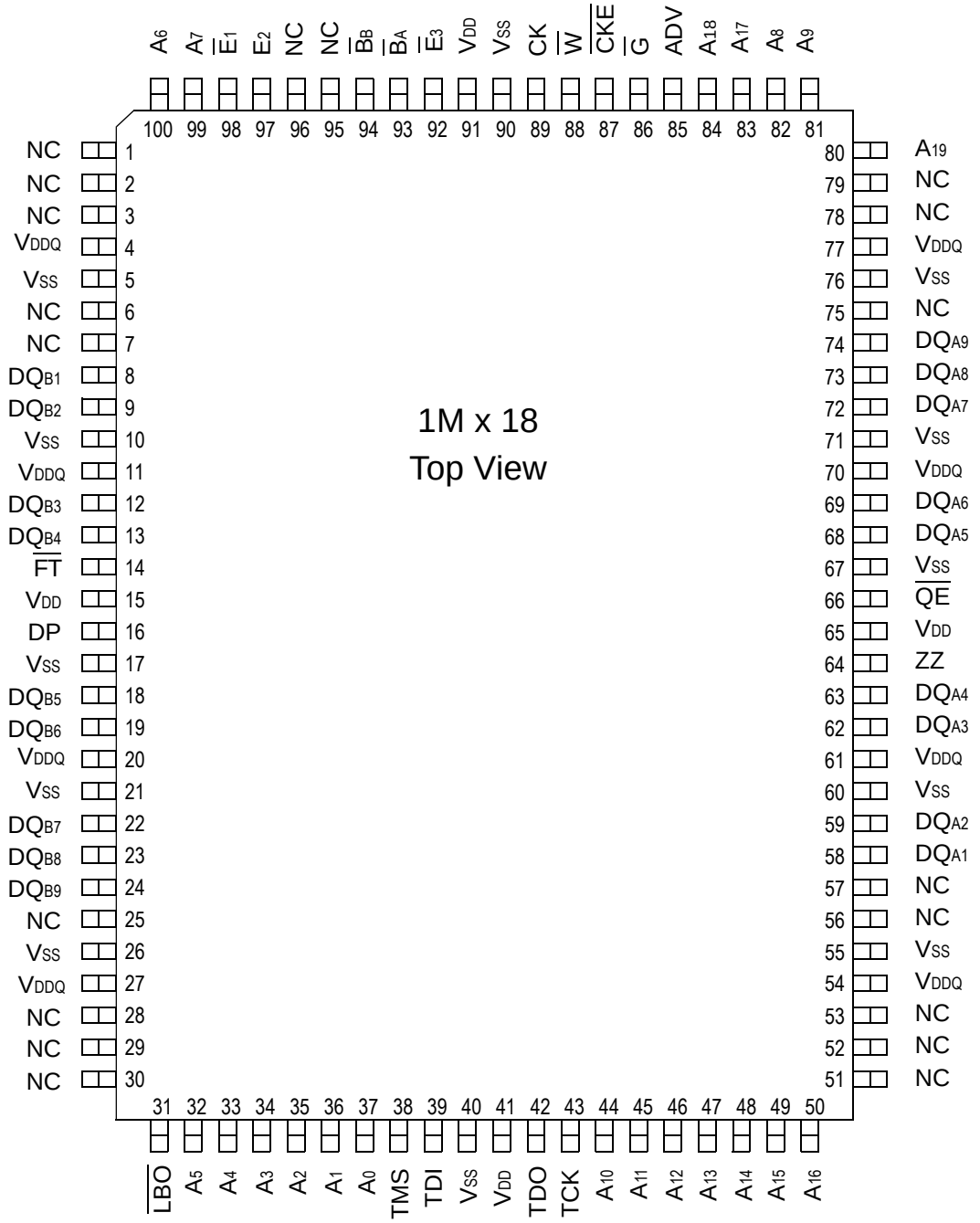
The GS8161Z18/36T may be configured by the user to operate in pipelined or flow through mode. Operating as a pipelined synchronous device, meaning that in addition to the rising edge triggered registers that capture input signals, the device incorporates a rising edge triggered output register. For read cycles, pipelined SRAM output data is temporarily stored by the edge triggered output register during the access cycle and then released to the output drivers at the next rising edge of clock.

The GS8161Z18/36T is implemented with GSI's high performance CMOS technology and is available in a JEDEC Standard 100 pin TQFP package.

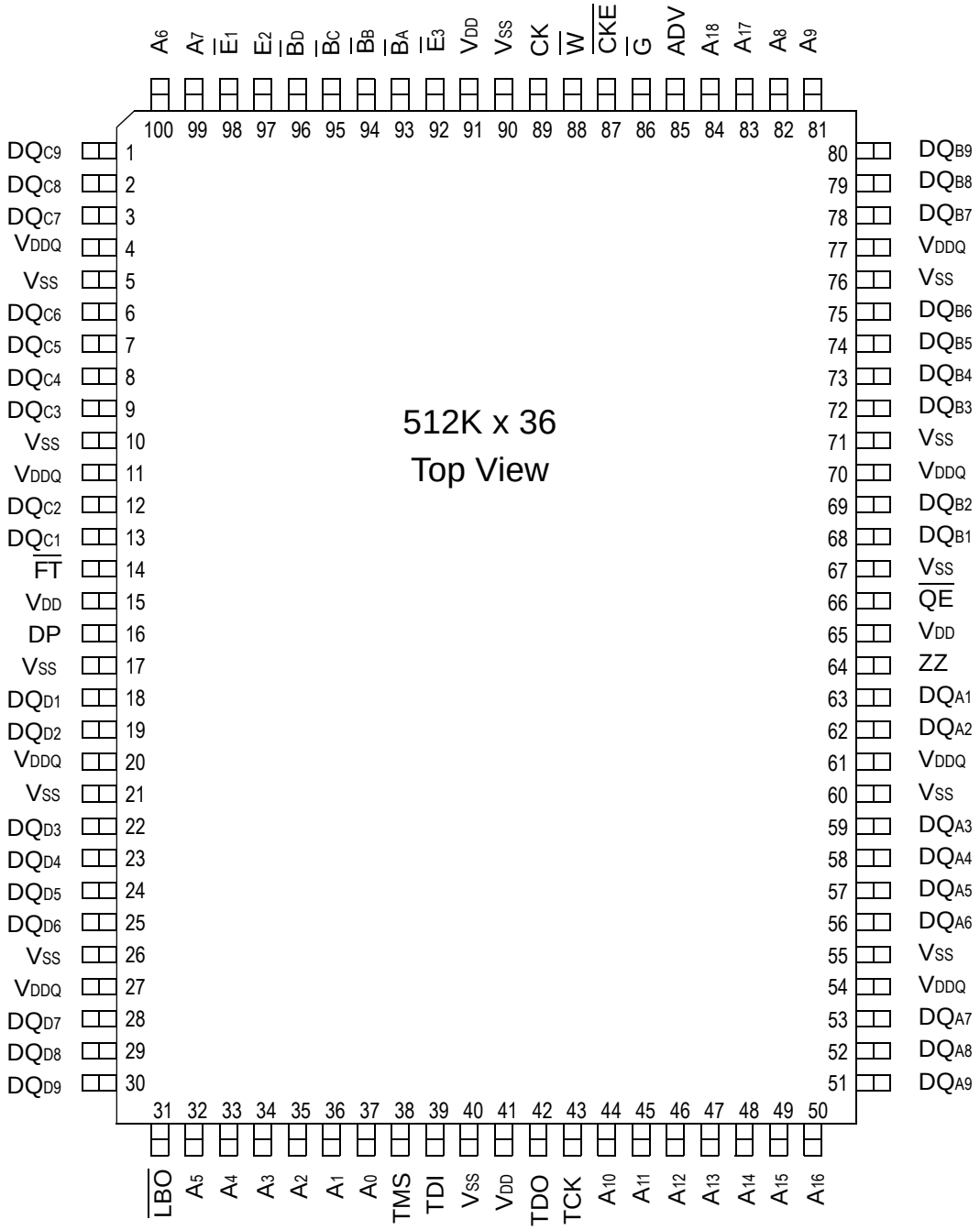
Flow Through and Pipelined NBT SRAM Back-to-Back Read/Write Cycles



GS8161Z18T Pinout



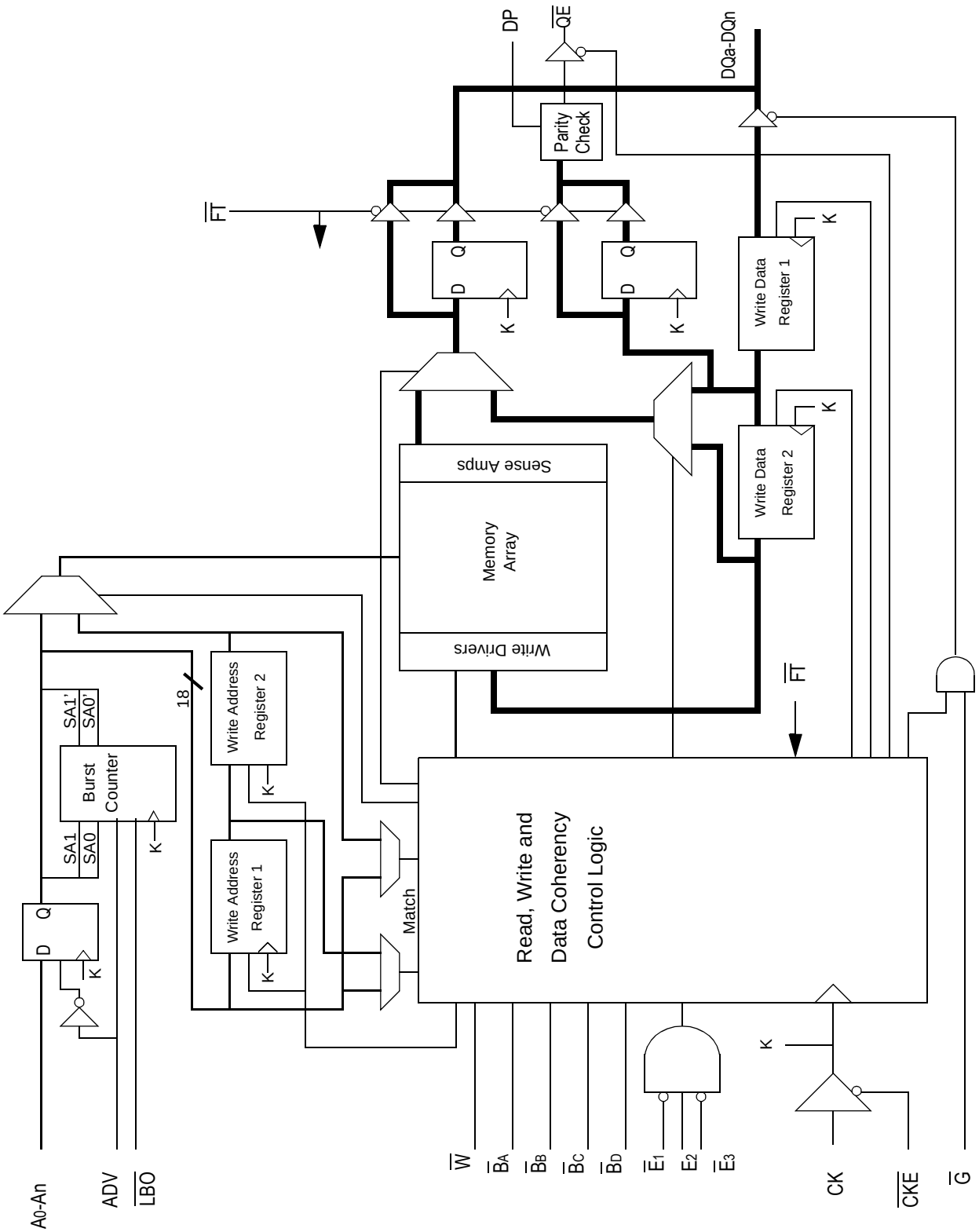
GS8161Z36T Pinout



100 Pin TQFP Pin Descriptions

Pin Location	Symbol	Type	Description
37, 36	A_0, A_1	In	Burst Address Inputs. Preload the burst counter.
35, 34, 33, 32, 100, 99, 84, 83, 82, 81, 44, 45, 46,47, 48, 49, 50	$A_{2\text{-}18}$	In	Address Inputs
80	A_{19}	In	Address Input (x18 Version Only)
89	CK	In	Clock Input Signal.
93	$\overline{B}_A$	In	Byte Write signal for data inputs DQ_{A1}-DQ_{A9}. Active Low
94	$\overline{B}_B$	In	Byte Write signal for data inputs DQ_{B1}-DQ_{B9}. Active Low
95	$\overline{B}_C$	In	Byte Write signal for data inputs DQ_{C1}-DQ_{C9}. Active Low (x36 Versions Only)
96	$\overline{B}_D$	In	Byte Write signal for data inputs DQ_{D1}-DQ_{D9}. Active Low (x36 Versions Only)
88	$\overline{W}$	In	Write Enable. Active Low
98	$\overline{E}_1$	In	Chip Enable. Active Low
97	E_2	In	Chip Enable. Active High. For self decoded depth expansion.
92	$\overline{E}_3$	In	Chip Enable. Active Low. For self decoded depth expansion.
86	$\overline{G}$	In	Output Enable. Active Low
85	ADV	In	Advance / $\overline{\text{Load}}$. Burst address counter control pin.
87	$\overline{CKE}$	In	Clock Input Buffer Enable. Active Low.
58, 59, 62,63, 68, 69, 72, 73, 74	DQ_{A1}-DQ_{A9}	I/O	Byte A Data Input and Output pins. (x18 Version Only)
8, 9, 12, 13, 18, 19, 22, 23, 24	DQ_{B1}-DQ_{B9}	I/O	Byte B Data Input and Output pins. (x18 Version Only)
51, 52, 53, 56, 57, 75, 78, 79, 1, 2, 3, 6, 7, 25, 28, 29, 30	NC	-	No Connect. (x18 Version Only)
51, 52, 53, 56, 57, 58, 59, 62,63	DQ_{A1}-DQ_{A9}	I/O	Byte A Data Input and Output pins. (x36 Versions Only)
68, 69, 72, 73, 74, 75, 78, 79, 80	DQ_{B1}-DQ_{B9}	I/O	Byte B Data Input and Output pins. (x36 Versions Only)
1, 2, 3, 6, 7, 8, 9, 12, 13	DQ_{C1}-DQ_{C9}	I/O	Byte C Data Input and Output pins. (x36 Versions Only)
18, 19, 22, 23, 24, 25, 28, 29, 30	DQ_{D1}-DQ_{D9}	I/O	Byte D Data Input and Output pins. (x36 Versions Only)
64	ZZ	In	Power down control. Active High.
14	$\overline{FT}$	In	Pipeline / $\overline{\text{Flow through}}$ Mode Control. Active Low.
31	$\overline{LBO}$	In	Linear Burst Order. Active Low.
38	TMS		Scan Test Mode Select
39	TDI		Scan Test Data In
42	TDO		Scan Test Data Out
43	TCK		Scan Test Clock
15, 41, 65, 91	V_{DD}	In	3.3V power supply.
5,10, 17, 21, 26, 40, 55, 60, 67, 71, 76, 90	V_{SS}	In	Ground.
4, 11, 20, 27, 54, 61, 70, 77	V_{DDQ}	In	3.3V output power supply for noise reduction.
16	DP	In	Parity Input. 1 = Even, 0 = Odd.
66	$\overline{QE}$	Out	Parity Error Out. Open Drain Output.

GS8161Z18/36 ByteSafe NBT SRAM Functional Block Diagram



Functional Details

Clocking

Deassertion of the Clock Enable ($\overline{CKE}$) input blocks the Clock input from reaching the RAM's internal circuits. It may be used to suspend RAM operations. Failure to observe Clock Enable set-up or hold requirements will result in erratic operation.

Pipelined Mode Read and Write Operations

All inputs (with the exception of Output Enable, Linear Burst Order and Sleep) are synchronized to rising clock edges. Single cycle read and write operations must be initiated with the Advance/$\overline{Load}$ pin ($\overline{ADV}$) held low, in order to load the new address. Device activation is accomplished by asserting all three of the Chip Enable inputs ($\overline{E}_1$, E_2 and $\overline{E}_3$). Deassertion of any one of the Enable inputs will deactivate the device.

Function	$\overline{W}$	$\overline{B}_A$	$\overline{B}_B$	$\overline{B}_C$	$\overline{B}_D$
Read	H	X	X	X	X
Write Byte a	L	L	H	H	H
Write Byte b	L	H	L	H	H
Write Byte c	L	H	H	L	H
Write Byte d	L	H	H	H	L
Write all Bytes	L	L	L	L	L
Write Abort/NOP	L	H	H	H	H

Read operation is initiated when the following conditions are satisfied at the rising edge of clock: $\overline{CKE}$ is asserted Low, all three chip enables ($\overline{E}_1$, E_2 and $\overline{E}_3$) are active, the write enable input signals $\overline{W}$ is deasserted high, and ADV is asserted Low. The address presented to the address inputs is latched in to 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 the input of the output register. At the next rising edge of clock the read data is allowed to propagate through the output register and onto the Output pins.

Write operation occurs when the RAM is selected, CKE is active and the Write input is sampled low at the rising edge of clock. The Byte Write Enable inputs ($\overline{B}_A$, $\overline{B}_B$, $\overline{B}_C$ & $\overline{B}_D$) determine which bytes will be written. All or none may be activated. A Write Cycle with no Byte Write inputs active is a no-op cycle. The Pipelined NBT SRAM provides double late write functionality, matching the write command vs. data pipeline length (2 cycles) to the read command vs. data pipeline length (2 cycles). At the first rising edge of clock, Enable, Write, Byte Write(s) and Address are registered. The Data In associated with that address is required at the third rising edge of clock.

Flow through Mode Read and Write Operations

Operation of the RAM in flow through mode is very similar to operations in pipelined mode. Activation of a Read Cycle and the use of the Burst Address Counter is identical. In flow through mode the device may begin driving out new data immediately after new address are clocked into the RAM, rather than holding new data until the following (second) clock edge. So, in flow through mode the read pipeline is one cycle shorter than in pipelined mode.

Write operations are initiated in the same way as well but differ in that the write pipeline is one cycle shorter as well, preserving the ability to turn the bus from reads to writes without inserting any dead cycles. While the pipelined NBT RAMs implement a double late write protocol, in flow through mode a single late write protocol mode is observed. So in flow through mode, address and control are registered on the first rising edge of clock and data in is required at the data input pins at the second rising edge of clock.

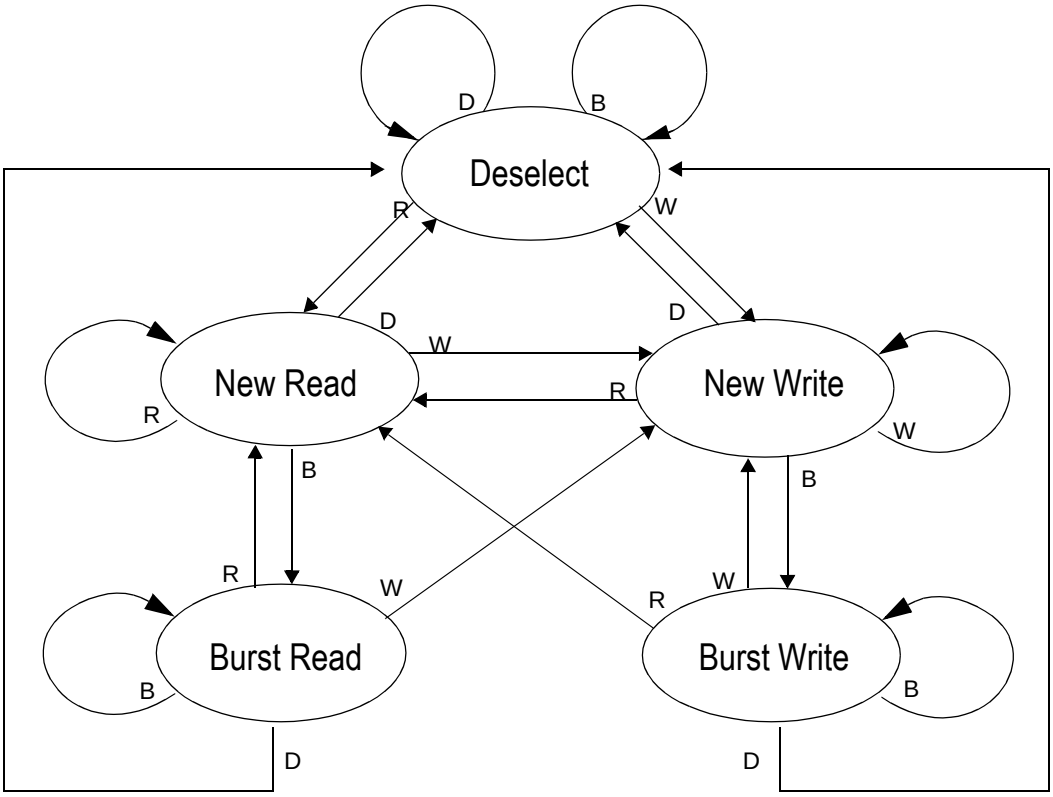
Synchronous Truth Table

Operation	Type	Address	$\overline{E}_1$	E_2	$\overline{E}_3$	ZZ	ADV	$\overline{W}$	$\overline{Bx}$	$\overline{G}$	$\overline{CKE}$	CK	DQ	Notes
Deselect Cycle, Power Down	D	None	H	X	X	L	L	X	X	X	L	L-H	High-Z	
Deselect Cycle, Power Down	D	None	X	X	H	L	L	X	X	X	L	L-H	High-Z	
Deselect Cycle, Power Down	D	None	X	L	X	L	L	X	X	X	L	L-H	High-Z	
Deselect Cycle, Continue	D	None	X	X	X	L	H	X	X	X	L	L-H	High-Z	1
Read Cycle, Begin Burst	R	External	L	H	L	L	L	H	X	L	L	L-H	Q	
Read Cycle, Continue Burst	B	Next	X	X	X	L	H	X	X	L	L	L-H	Q	1,10
NOP/Read, Begin Burst	R	External	L	H	L	L	L	H	X	H	L	L-H	High-Z	2
Dummy Read, Continue Burst	B	Next	X	X	X	L	H	X	X	H	L	L-H	High-Z	1,2,10
Write Cycle, Begin Burst	W	External	L	H	L	L	L	L	L	X	L	L-H	D	3
Write Cycle, Continue Burst	B	Next	X	X	X	L	H	X	L	X	L	L-H	D	1,3,10
NOP/Write Abort, Begin Burst	W	None	L	H	L	L	L	L	H	X	L	L-H	High-Z	2,3
Write Abort, Continue Burst	B	Next	X	X	X	L	H	X	H	X	L	L-H	High-Z	1,2,3,10
Clock Edge Ignore, Stall		Current	X	X	X	L	X	X	X	X	H	L-H	-	4
Sleep Mode		None	X	X	X	H	X	X	X	X	X	X	High-Z	

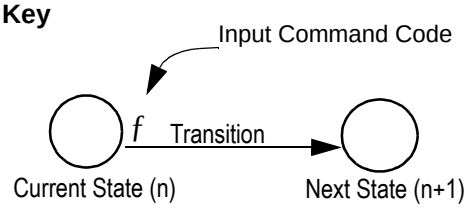
Notes

1. Continue Burst cycles, whether Read or Write, use the same control inputs. A Deselect continue cycle can only be entered into if a Deselect cycle is executed first.
2. Dummy Read and Write abort can be considered NOP s because the SRAM performs no operation. A Write abort occurs when the $\overline{W}$ pin is sampled low but no Byte Write pins are active so no Write operation is performed.
3. $\overline{G}$ can be wired low to minimize the number of control signals provided to the SRAM. Output drivers will automatically turn off during Write cycles.
4. If $\overline{CKE}$ High occurs during a pipelined Read cycle, the DQ bus will remain active (Low Z). If $\overline{CKE}$ High occurs during a Write cycle, the bus will remain in High Z.
5. X = Don t Care. H = Logic High. L = Logic Low. $\overline{Bx}$ = High = All Byte Write signals are high. $\overline{Bx}$ = Low = One or more Byte/Write signals are Low.
6. All inputs, except $\overline{G}$ and ZZ must meet setup and hold times of rising clock edge.
7. Wait states can be inserted by setting $\overline{CKE}$ high.
8. This device contains circuitry that ensures all outputs are in High Z during power-up.
9. A 2-bit burst counter is incorporated.
10. The address counter is incriminated for all Burst continue cycles.

Pipelined and Flow through Read Write Control State Diagram

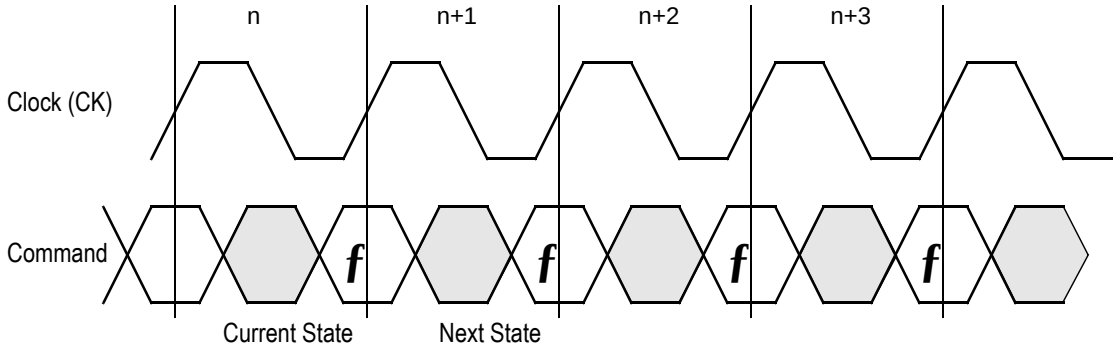


Key



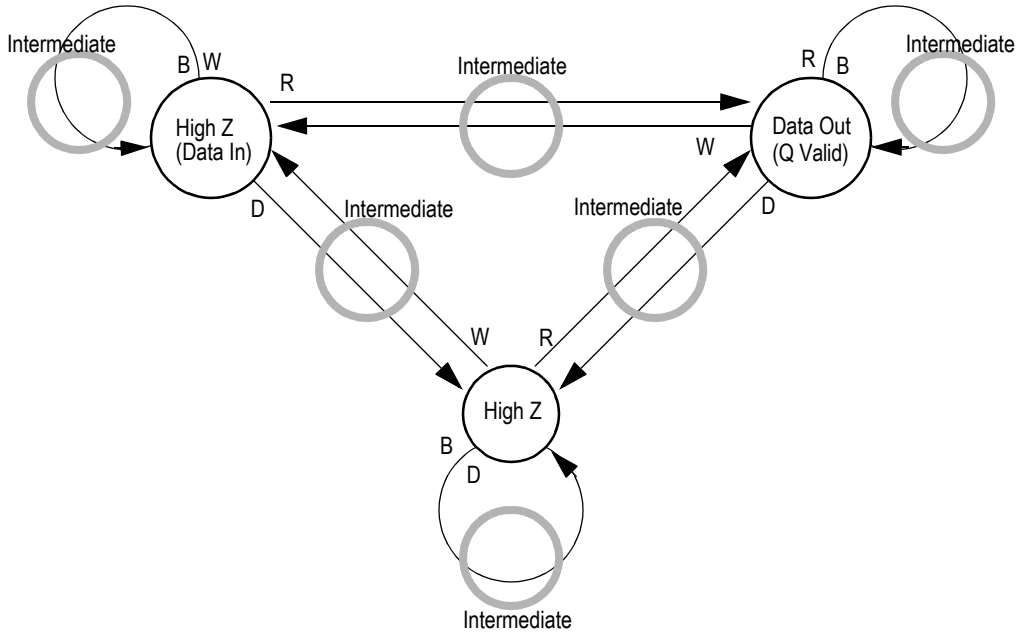
Notes

1. The Hold command ($\overline{CKE}$ Low) is not shown because it prevents any state change.
2. W, R, B and D represent input command codes as indicated in the Synchronous Truth Table.

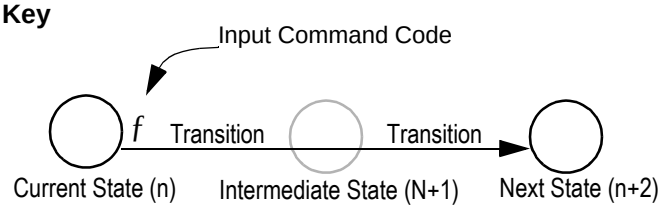


Current State & Next State Definition for Pipelined and Flow through Read / Write Control State Diagram

Pipelined Mode Data I/O State Diagram



Key



Notes

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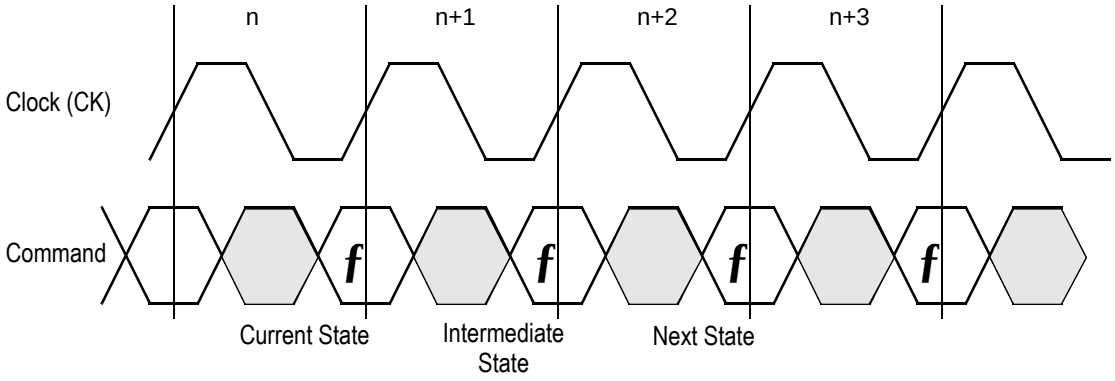
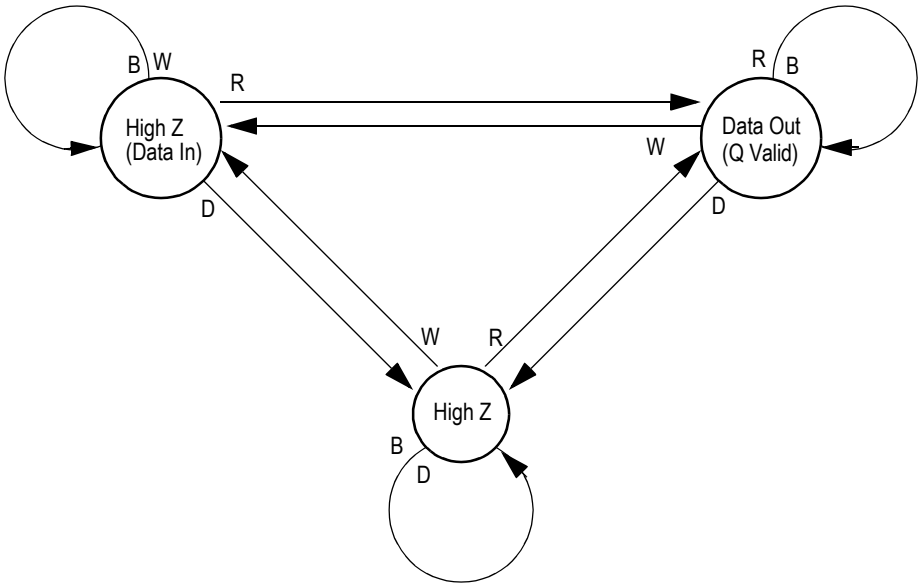
2. W, R, B and D represent input command codes as indicated in the Truth Tables.

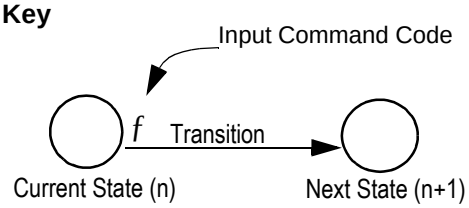


Current State & Next State Definition for Pipelined Mode Data I/O State Diagram

Flow through Mode Data I/O State Diagram



Key



Notes

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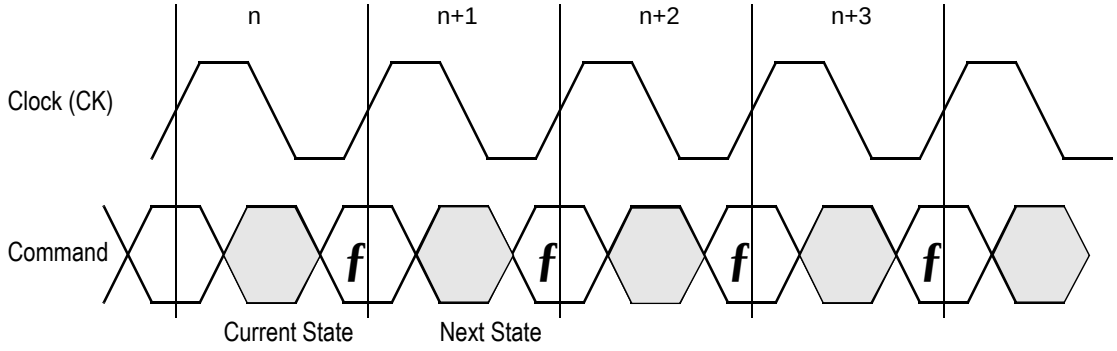
2. W, R, B and D represent input command codes as indicated in the Truth Tables.



Current State & Next State Definition for: Pipelined and Flow through Read Write Control State Diagrar

Flow through Read Write Control State Diagram

Burst Cycles

Although NBT RAMs are designed to sustain 100% bus bandwidth by eliminating turnaround cycle when there is transition from Read to Write, multiple back-to-back reads or writes may also be performed. NBT SRAMs 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 SRAM to advance the internal address counter and use the counter generated address to read or write the SRAM. The starting address for the first cycle in a burst cycle series is loaded into the SRAM 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. The burst sequence is determined by the state of the Linear Burst Order pin ($\overline{LBO}$). When this pin is Low, a linear burst sequence is selected. When the RAM is installed with the LBO pin tied high, Interleaved burst sequence is selected. See the tables below for details.

Mode Pin Functions

Mode Name	Pin Name	State	Function
Burst Order Control	$\overline{LBO}$	L	Linear Burst
		H or NC	Interleaved Burst
Output Register Control	$\overline{FT}$	L	Flow Through
		H or NC	Pipeline
Power Down Control	ZZ	L or NC	Active
		H	Standby, $I_{DD} = I_{SB}$
ByteSafe Data Parity Control	DP	L	Check for Odd Parity
		H or NC	Check for Even Parity

Note:
There are pull up devices on the $\overline{LBO}$, DP, and $\overline{FT}$ pins and a pull down device on the ZZ pin, so those input pins can be unconnected and the chip will operate in the default states as specified in the above tables.

Burst Counter Sequences

Linear Burst Sequence

	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: The burst counter wraps to initial state on the 5th clock.

Interleaved Burst Sequence

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

Note: The burst counter wraps to initial state on the 5th clock.

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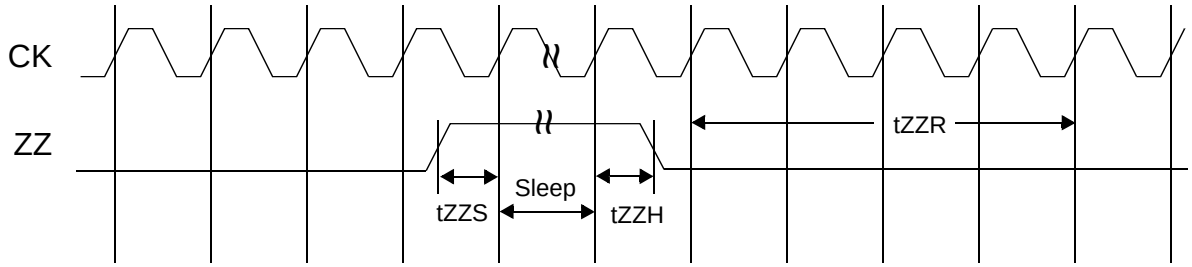
Sleep Mode

During normal operation, ZZ must be pulled low, either by the user or by it s internal pull down resistor. When ZZ is pulled high, the SRAM will enter a Power Sleep Mode after 2 cycles. At this time, internal state of the SRAM is preserved. When ZZ returns to low, the SRAM operates normally after 2 cycles of wake up time.

Sleep Mode is a low current, power-down mode in which the device is deselected and current is reduced to $I_{SB}2$. The duration of Sleep Mode is

dictated by the length of time the ZZ is in a High state. After entering Sleep Mode, all inputs except ZZ become disabled and all outputs go to High-Z The ZZ pin is an asynchronous, active high input that causes the device to enter Sleep Mode. When the ZZ pin is driven high, $I_{SB}2$ is guaranteed after the time tZZI is met. Because ZZ is an asynchronous input, pending operations or operations in progress may not be properly completed if ZZ is asserted. Therefore, Sleep Mode must not be initiated until valid pending operations are completed. Similarly, when exiting Sleep Mode during tZZR, only a Deselect or Read commands may be applied while the SRAM is recovering from Sleep Mode.

Sleep Mode Timing Diagram



Designing for Compatibility

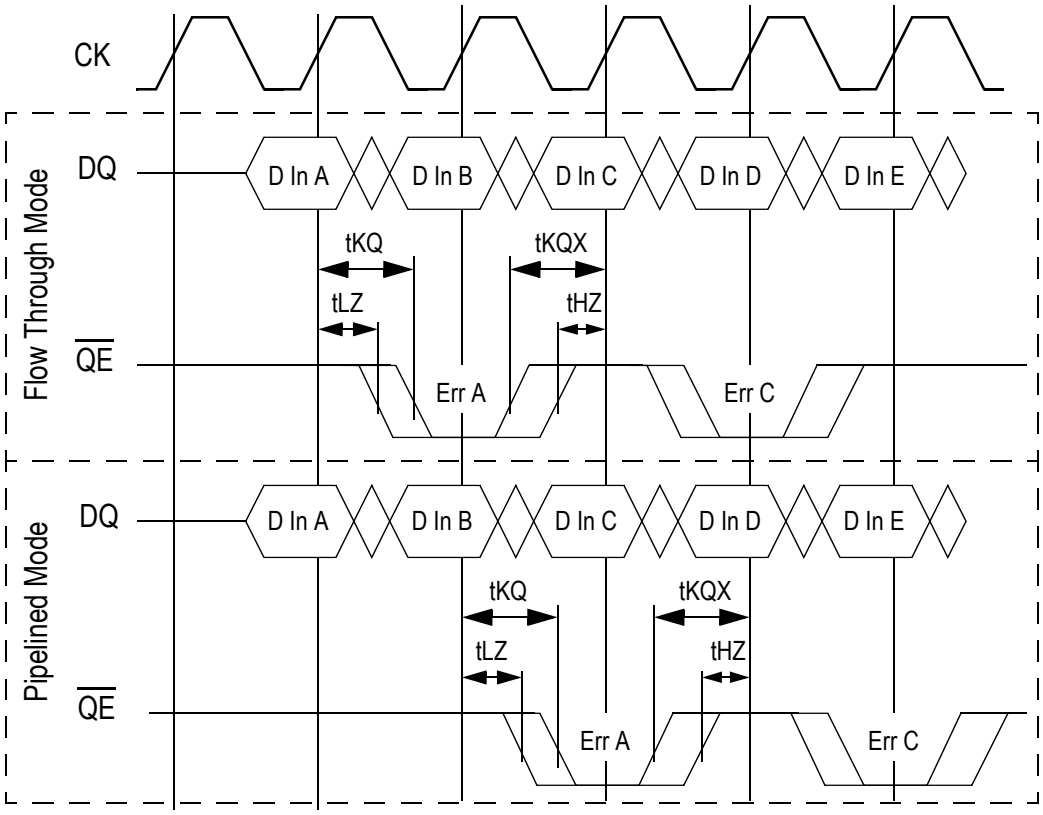
The GSI NBT SRAMs offer users a configurable selection between flow through mode and pipelined mode via the $\overline{FT}$ signal found on pin 14. Not all vendors offer this option, however most mark pin 14 as V_{DD} or V_{DDQ} on pipelined parts and V_{SS} on flow through parts. GSI NBT SRAMs are fully compatible with these sockets.

Pin 66, a No Connect (NC) on GSI s GS8160Z18/36 NBT SRAM, the Parity Error open drain output on GSI s GS8161Z18/36 NBT SRAM, is often marked as a power pin on other vendor s NBT compatible SRAMs. Specifically, it is marked V_{DD} or V_{DDQ} on pipelined parts and V_{SS} on flow through parts. Users of GSI NBT devices who are not actually using the ByteSafe parity feature may want to design the board site for the RAM with pin 66 tied high through a 1k ohm resistor in pipeline mode applications or tied low in flow through applications in order to keep the option to use non-configurable devices open. By using the pull-up resistor, rather than tying the pin to one of the power rails, users interested in upgrading to GSI s ByteSafe NBT SRAMs (GS8161Z18/36), featuring Parity Error detection and JTAG Boundary Scan, will be ready for connection to the active low, open drain Parity Error output driver at pin 66 on GSI s TQFP ByteSafe RAMs.

ByteSafe Parity Functions

This SRAM includes a write data parity check that checks the validity of data coming into the RAM on write cycles. In flow through mode, write data errors are reported in the cycle following the data input cycle. In pipeline mode, write data errors are reported one clock cycle later. (See timing diagram below.) The Data Parity Mode (DP) pin must be tied high to set the RAM to check for Even parity or low to check for Odd parity. Read data parity is not checked by the RAM as data validity is best established at the data s destination. The Parity Error Output is an open drain output and drives low to indicate a parity error. Multiple Parity Error Output pins may share a common pull-up resistor.

x18/x36 Mode Write Parity Error Output Timing Diagram



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Absolute Maximum Ratings

(All voltages reference to V_{SS})

Symbol	Description	Value	Unit
V_{DD}	Voltage on V_{DD} Pins	-0.5 to 3.6	V
V_{DDQ}	Voltage in V_{DDQ} Pins	-0.5 to 3.6	V
V_{CK}	Voltage on Clock Input Pin	-0.5 to 6	V
$V_{I/O}$	Voltage on I/O Pins	-0.5 to V_{DDQ}+0.5 (≤ 3.6 V max.)	V
V_{IN}	Voltage on Other Input Pins	-0.5 to 3.6	V
I_{IN}	Input Current on Any Pin	+/- 20	mA
I_{OUT}	Output Current on Any I/O Pin	+/- 20	mA
P_D	Package Power Dissipation	1.5	W
T_{STG}	Storage Temperature	-55 to 125	°C
T_{BIAS}	Temperature Under Bias	-55 to 125	°C

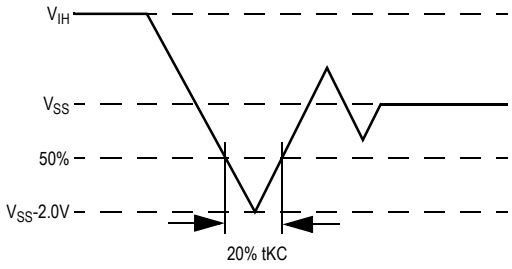
Note:
Permanent damage to the device may occur if the Absolute Maximum Ratings are exceeded. Operation should be restricted to Recommended Operating Conditions. Exposure to conditions exceeding the Absolute Maximum Ratings, for an extended period of time, may affect reliability of this component.

Recommended Operating Conditions

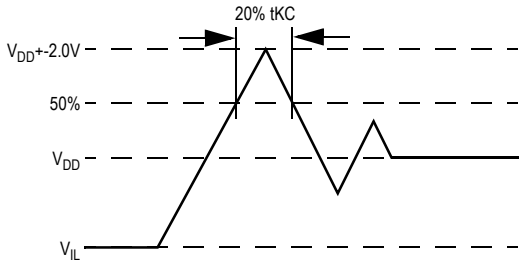
Parameter	Symbol	Min.	Typ.	Max.	Unit	Notes
Supply Voltage	V_{DD}	2.375	2.5	2.7	V	
I/O Supply Voltage	V_{DDQ}	2.375	2.5	3.6	V	
Input High Voltage	V_{IH}	0.3 * VDD	---	3.6	V	1
Input Low Voltage	V_{IL}	-0.3	---	0.7 * VDD	V	1
Ambient Temperature (Commercial Range Versions)	T_A	0	25	70	°C	2
Ambient Temperature (Industrial Range Versions)	T_A	-40	25	85	°C	2

Note:
11. The part number of Industrial Temperature Range versions end the character I . Unless otherwise noted, all performance specifications quoted are evaluated for worst case in the temperature range marked on the device.
12. Input Under/overshoot voltage must be -2V > Vi < V_{DD}+2V with a pulse width not to exceed 20% tKC.

Undershoot Measurement and Timing



Overshoot Measurement and Timing



Capacitance

(T_A=25°C, f=1MHz, V_{DD}=2.5V)

Parameter	Symbol	Test conditions	Typ.	Max.	Unit
Control Input Capacitance	C_I	V_{DD} = 2.5V	3	4	pF
Input Capacitance	C_{IN}	V_{IN} = 0V	4	5	pF
Output Capacitance	C_{OUT}	V_{OUT} = 0V	6	7	pF

Note: This parameter is sample tested.

Package Thermal Characteristics

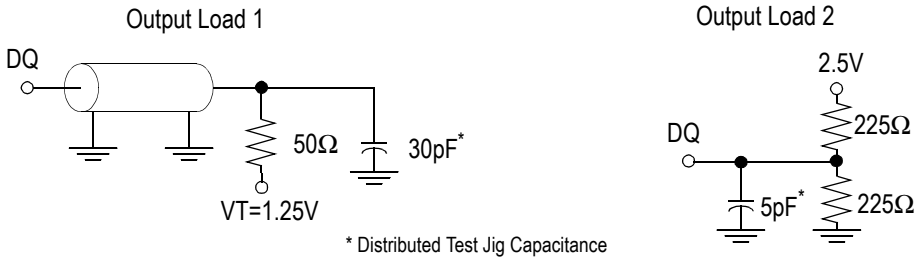
Rating	Layer Board	Symbol	Max	Unit	Notes
Junction to Ambient (at 200 lfm)	single	$R_{\Theta JA}$	40	°C/W	1,2
Junction to Ambient (at 200 lfm)	four	$R_{\Theta JA}$	24	°C/W	1,2
Junction to Case (TOP)		$R_{\Theta JC}$	9	°C/W	3

Notes:
1. Junction temperature is a function of SRAM power dissipation, package thermal resistance, mounting board temperature, ambient. Temperature air flow, board density, and PCB thermal resistance.
2. SCMI G-38-87.
3. Average thermal resistance between die and top surface, MIL SPEC-883, Method 1012.1.

AC Test Conditions

Parameter	Conditions
Input high level	2.3V
Input low level	0.2V
Input slew rate	1V/ns
Input reference level	1.25V
Output reference level	1.25V
Output load	Fig. 1& 2

Notes:
1. Include scope and jig capacitance.
2. Test conditions as specified with output loading as shown in Fig. 1 unless otherwise noted.
3. Output Load 2 for t_{LZ}, t_{HZ}, t_{OLZ} and t_{OHZ}.
4. Device is deselected as defined by the Truth Table.



DC Electrical Characteristics

Parameter	Symbol	Test Conditions	Min	Max
Input Leakage Current (except mode pins)	I_{IL}	V_{IN} = 0 to V_{DD}	-1uA	1uA
ZZ Input Current	I_{INZZ}	$V_{DD} \geq V_{IN} \geq V_{IH}$ $0V \leq V_{IN} \leq V_{IH}$	-1uA -1uA	1uA 300uA
Mode Pin Input Current	I_{INM}	$V_{DD} \geq V_{IN} \geq V_{IL}$ $0V \leq V_{IN} \leq V_{IL}$	-300uA -1uA	1uA 1uA
Output Leakage Current	I_{OL}	Output Disable, V_{OUT} = 0 to V_{DD}	-1uA	1uA
Output High Voltage	V_{OH}	I_{OH} = -8 mA, V_{DDQ}=2.375V	1.7V	
Output High Voltage	V_{OH}	I_{OH} = -8 mA, V_{DDQ}=3.135V	2.4V	
Output Low Voltage	V_{OL}	I_{OL} = 8 mA		0.4V

Operating Currents (x18 & x36)

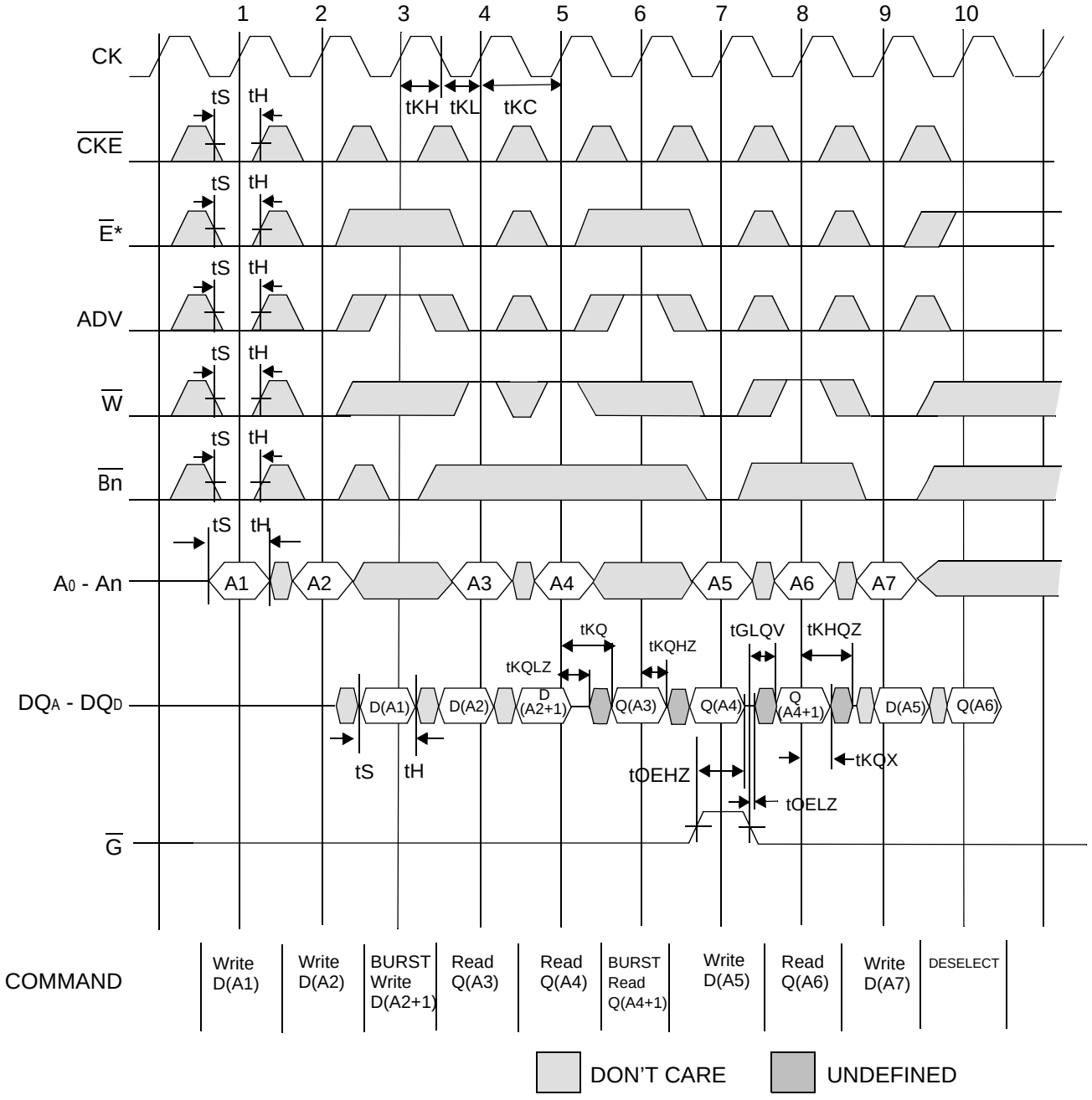
Parameter	Test Conditions	Symbol	-200		-180		-166		-150		-133	
			0 to 70°C	-40 to 85°C	0 to 70°C	-40 to 85°C	0 to 70°C	-40 to 85°C	0 to 70°C	-40 to 85°C	0 to 70°C	-40 to 85°C
Operating Current	Device Selected; All other inputs ≥V_{IH} or ≤ V_{IL} Output open	I_{DD} Flow-Thru	390mA	400mA	360mA	370mA	330mA	340mA	300mA	310mA	270mA	280mA
Standby Current	ZZ ≥ V_{DD} - 0.2V	I_{SB} Flow-Thru	10mA	20mA	10mA	20mA	10mA	20mA	10mA	20mA	10mA	20mA
Deselect Current	Device Deselected; All other inputs ≥ V_{IH} or ≤ V_{IL}	I_{DD} Flow-Thru	90mA	95mA	85mA	90mA	75mA	80mA	65mA	70mA	55mA	60mA

AC Electrical Characteristics

	Parameter	Symbol	-200		-180		-166		-150		-133		Unit
			Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	
Pipeline	Clock Cycle Time	tKC	5.0	---	5.5	---	6.0	---	6.7	---	7.5	---	ns
	Clock to Output Valid	tKQ	---	3.0	---	3.2	---	3.2	---	3.8	---	4.0	ns
	Clock to Output Invalid	tKQX	1.5	---	1.5	---	1.5	---	1.5	---	1.5	---	ns
	Clock to Output in Low-Z	tLZ[1]	1.5	---	1.5	---	1.5	---	1.5	---	1.5	---	ns
Flow-through	Clock Cycle Time	tKC	10.0	---	10.0	---	10.0	---	10.0	---	15.0	---	ns
	Clock to Output Valid	tKQ	---	7.5	---	8.0	---	8.0	---	10.0	---	11.0	ns
	Clock to Output Invalid	tKQX	3.0	---	3.0	---	3.0	---	3.0	---	3.0	---	ns
	Clock to Output in Low-Z	tLZ[1]	3.0	---	3.0	---	3.0	---	3.0	---	3.0	---	ns
	Clock HIGH Time	tKH	1.3	---	1.3	---	1.3	---	1.5	---	1.7	---	ns
	Clock LOW Time	tKL	1.5	---	1.5	---	1.5	---	1.7	---	2	---	ns
	Clock to Output in High-Z	tHZ[1]	1.5	3.0	1.5	3.2	1.5	3.2	1.5	3.8	1.5	4.0	ns
	$\overline{G}$ to Output Valid	tOE	---	3.2	---	3.2	---	3.2	---	3.8	---	4.0	ns
	$\overline{G}$ to output in Low-Z	tOLZ[1]	0	---	0	---	0	---	0	---	0	---	ns
	$\overline{G}$ to output in High-Z	tOHZ[1]	---	3.0	---	3.2	---	3.2	---	3.8	---	4.0	ns
	Setup time	tS	1.5	---	1.5	---	1.5	---	1.5	---	1.5	---	ns
	Hold time	tH	0.5	---	0.5	---	0.5	---	0.5	---	0.5	---	ns
	ZZ setup time	tZZS[2]	5	---	5	---	5	---	5	---	5	---	ns
	ZZ hold time	tZZH[2]	1	---	1	---	1	---	1	---	1	---	ns
	ZZ recovery	tZZR	100	---	100	---	100	---	100	---	100	---	ns

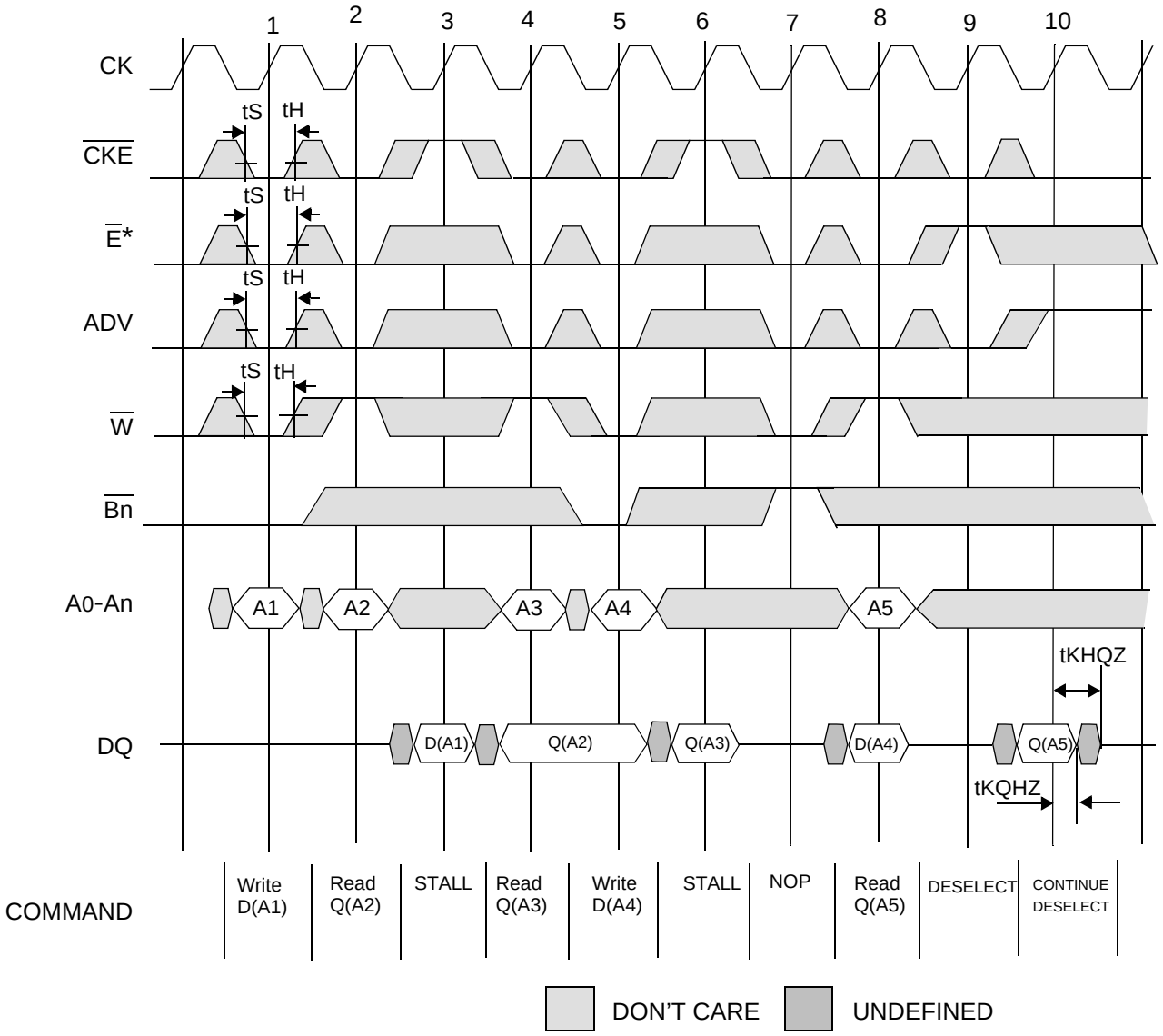
Notes:
1. These parameters are sampled and are not 100% tested
2. ZZ is an asynchronous signal. However, In order to be recognized on any given clock cycle, ZZ must meet the specified setup and hold times as specified above.

Pipelined Mode Read / Write Cycle Timing



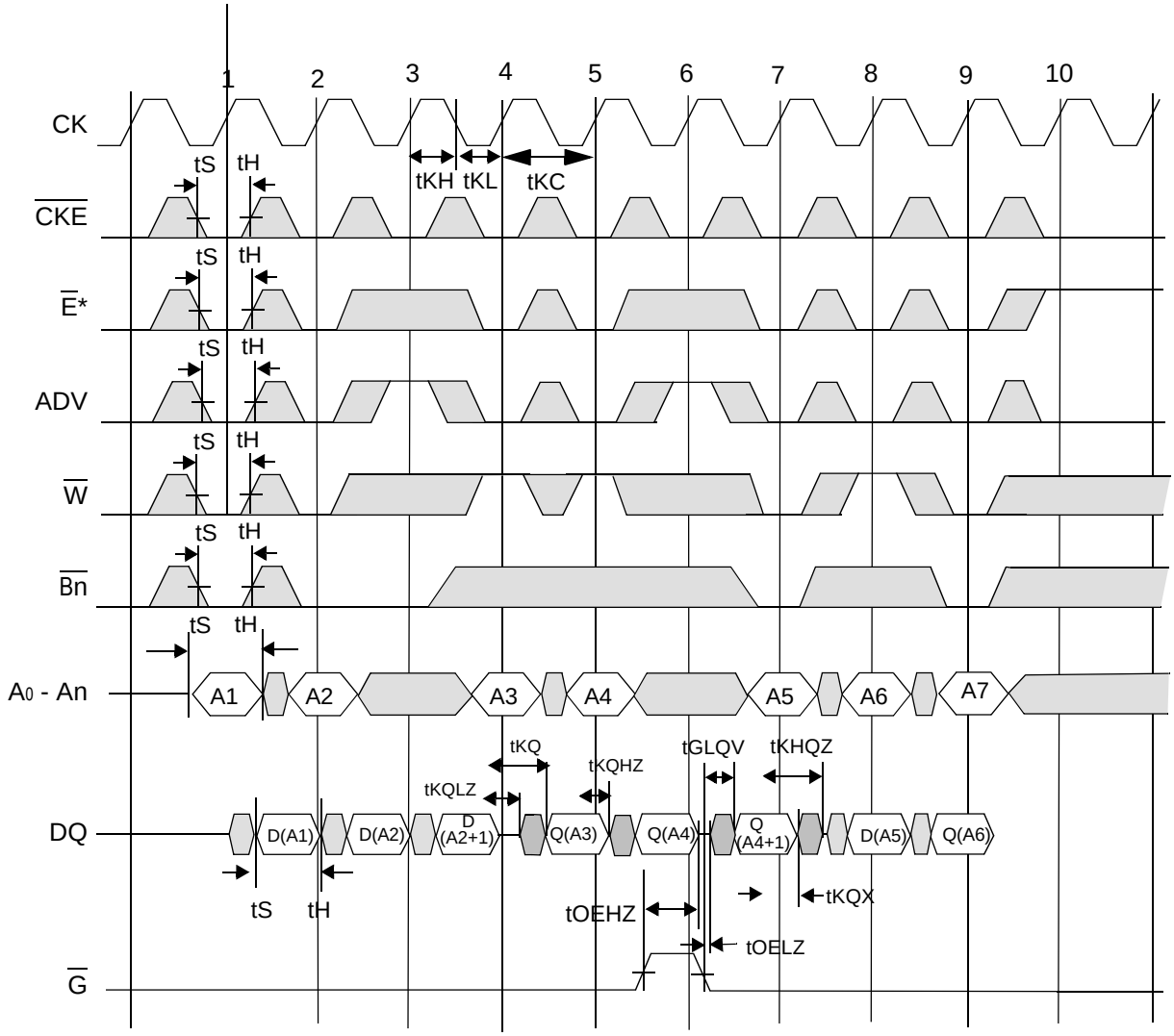
*Note: $\overline{E}$ = High (False) if $\overline{E}_1$ = 1 or E_2 = 0 or $\overline{E}_3$ = 1

Pipelined Mode No-Op, Stall and Deselect Timing



*Note: $\overline{E}$ = High (False) if $\overline{E}_1$ = 1 or E_2 = 0 or $\overline{E}_3$ = 1

Flow Through Mode Read / Write Cycle Timing

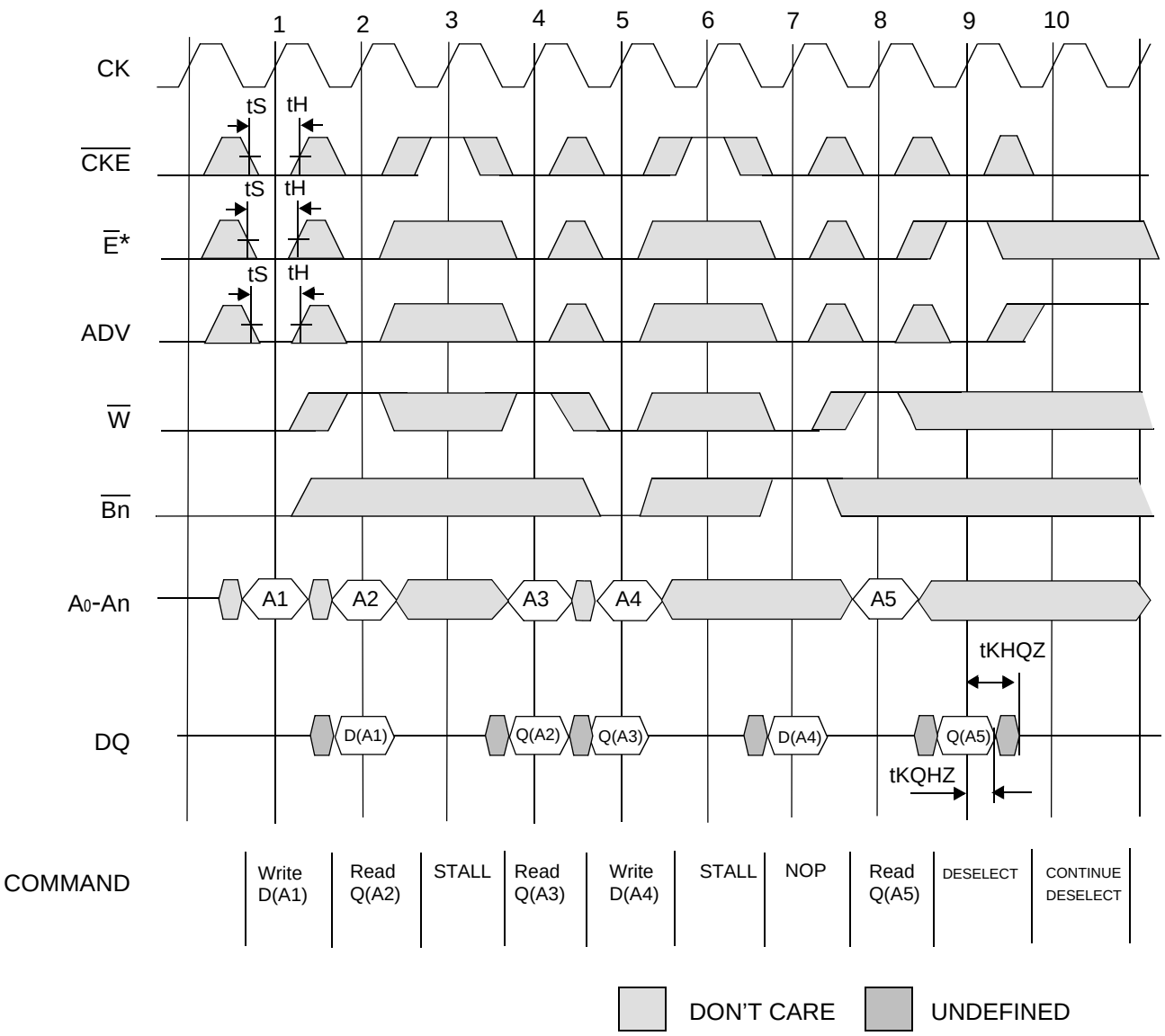


COMMAND	Write D(A1)	Write D(A2)	BURST Write D(A2+1)	Read Q(A3)	Read Q(A4)	BURST Read Q(A4+1)	Write D(A5)	Read Q(A6)	Write D(A7)	DESELECT

DON'T CARE UNDEFINED

*Note: $\overline{E}$ = High (False) if $\overline{E}_1$ = 1 or E_2 = 0 or $\overline{E}_3$ = 1

Flow Through Mode No-Op, Stall and Deselect Timing



*Note: $\overline{E}$ = High (False) if $\overline{E}_1$ = 1 or E_2 = 0 or $\overline{E}_3$ = 1

JTAG Port Operation

Overview

The JTAG Port on this RAM operates in a manner consistent with IEEE Standard 1149.1-1990, a serial boundary scan interface standard (commonly referred to as JTAG), but does not implement all of the functions required for 1149.1 compliance. Unlike JTAG implementations that have been common among SRAM vendors for the last several years, this implementation does offer a form of EXTEST, known as Clock Assisted EXTEST, reducing or eliminating the hand coding that has been required to overcome the test program compiler errors caused by previous non-compliant implementations. The JTAG Port interfaces with conventional 2.5V CMOS logic level signaling.

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. TCK, TDI and TMS are designed with internal pull-up circuits.To assure normal operation of the RAM with the JTAG Port unused, TCK, TDI and TMS may be left floating or tied to either V_{DD} or V_{SS}. 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 state machine. 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 state machine 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 state machine. 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 automaticly at power-up.

JTAG Port Registers

Overview

The various JTAG registers, refered to as Test Access Port orTAP Registers, are selected (one at a time) via the sequences of ones and zeros 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 three 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.

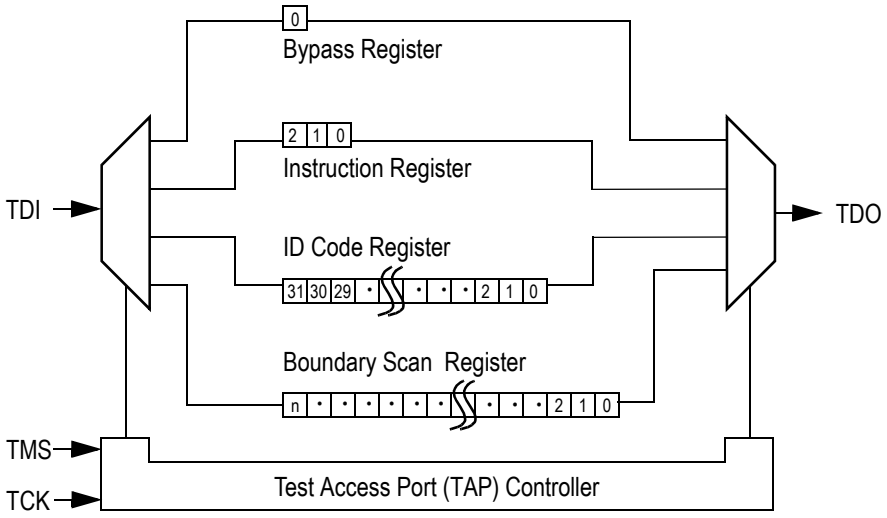
Bypass Register

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 RAMs JTAG Port to another device in the scan chain with as little delay as possible.

Boundary Scan Register

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 Scan Order Table following. The Boundary Scan Register, under the control of the TAP Controller, is loaded with the contents of the RAMs 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				GSI 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
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	1	0	0	1	1
x18	X	X	X	X	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	1	1	0	1	1	0	0	1	1

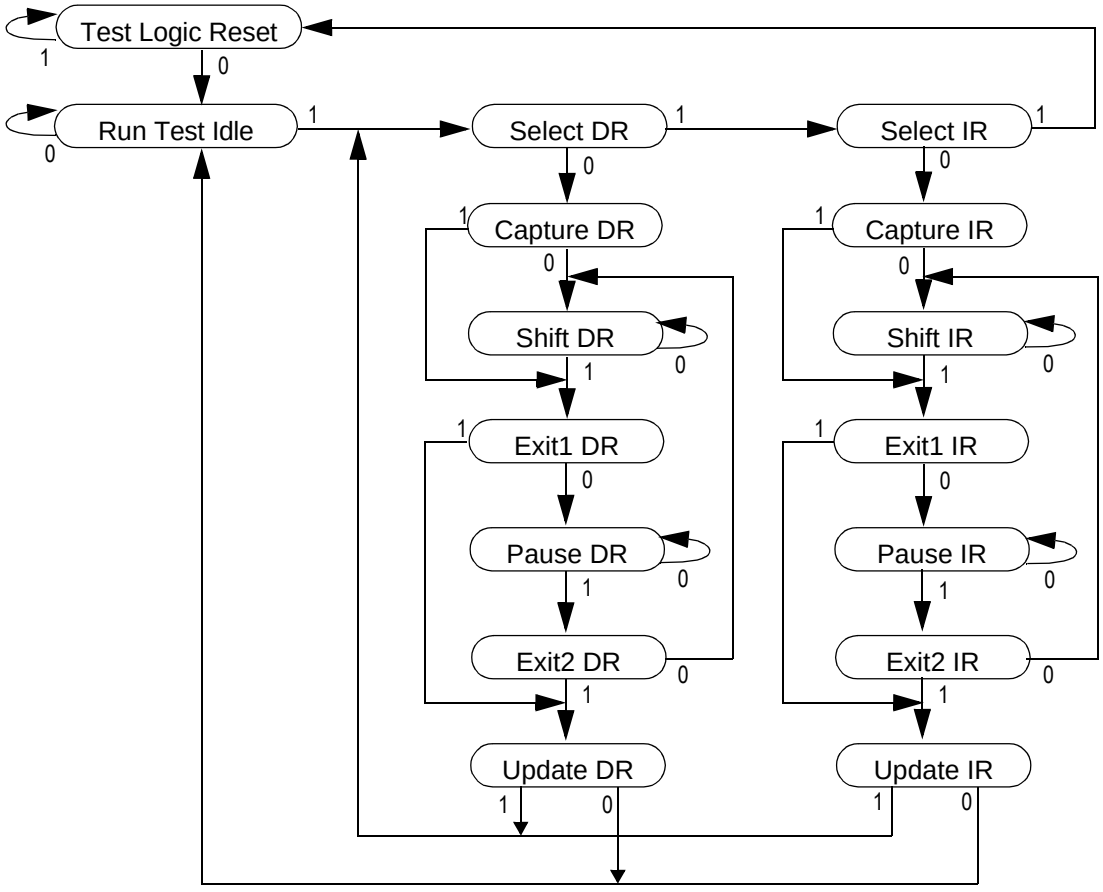
Tap Controller Instruction Set

Overview

There are two classes of instructions defined in the Standard 1149.1-1990; the 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. Although the TAP controller in this device follows the 1149.1 conventions, it is not 1194.1 compliant because some of the mandatory instructions are uniquely implemented. The TAP on this device may be used to monitor all input and I/O pads, but cannot be used to load address, data or control signals into the RAM or to preload the I/O buffers.This device will not perform INTEST or 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 01. 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 following table.

JTAG Tap Controller State Diagram



Instruction Descriptions

BYPASS

When the BYPASS instruction is loaded in 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. 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 TAPs input data capture set-up plus hold time (tTS plus tTH). The RAMs 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. Because the PRELOAD portion of the command is not implemented in this device, moving the controller to the Update-DR state with the SAMPLE / PRELOAD instruction loaded in the Instruction Register has the same effect as the Pause-DR command. This functionality is not Standard 1149.1 compliant.

EXTEST (EXTEST-A)

EXTEST is an IEEE 1149.1 mandatory public instruction. It is to be executed whenever the instruction register, whatever length it may be in the device, is loaded with all logic 0s. The EXTEST implementation in this device does not, without further user intervention, actually move the contents of the scan chain onto the RAM s output pins. Therefore this device is not strictly 1149.1 compliant. Nevertheless, this RAM s TAP does respond to an all zeros instruction, EXTEST (000), by overriding the RAM s control inputs and activating the Data I/O output drivers. The RAM s main clock (CK) may then be used to transfer Boundary Scan Register contents associated with each I/O from the scan register to the RAM s output drivers and onto the I/O pins. A single CK transition is sufficient to transfer the data, but more transitions will do no harm.

IDCODE

The IDCODE instruction causes the ID ROM to be loaded into 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 in the instruction register, all RAM outputs are forced to an inactive drive 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.

JTAG TAP Instruction Set Summary

Instruction	Code	Description	Notes
EXTEST-A	000	Places the Boundary Scan Register between TDI and TDO. This RAM implements an Clock Assisted EXTEST function. *Not 1149.1 Compliant *	1
IDCODE	001	Preloads ID Register and places it between TDI and TDO.	1, 2
SAMPLE-Z	010	Captures I/O ring contents. Places the Boundary Scan Register between TDI and TDO. Forces all RAM output drivers to High-Z.	1
RFU	011	Do not use this instruction; Reserved for Future Use. Replicates BYPASS instruction. Places Bypass Register between TDI and TDO.	1
SAMPLE/PRELOAD	100	Captures I/O ring contents. Places the Boundary Scan Register between TDI and TDO. This RAM does not implement 1149.1 PRELOAD function. *Not 1149.1 Compliant *	1
GSI	101	GSI private instruction.	1
RFU	110	Do not use this instruction; Reserved for Future Use. Replicates BYPASS instruction. Places Bypass Register between TDI and TDO.	1
BYPASS	111	Places Bypass Register between TDI and TDO.	1

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 Port Recommended Operating Conditions and DC Characteristics

Parameter	Symbol	Min.	Max.	Unit	Notes
Test Port Input High Voltage	V_{IHT}	0.7 * VDD	V_{DD}+0.3	V	1, 2
Test Port Input Low Voltage	V_{ILT}	-0.3	0.3 * VDD	V	1, 2
TMS, TCK and TDI Input Leakage Current	I_{INTH}	-300	1	uA	3
TMS, TCK and TDI Input Leakage Current	I_{INTL}	-1	1	uA	4
TDO Output Leakage Current	I_{OLT}	-1	1	uA	5
Test Port Output High Voltage	V_{OHT}	1.7		V	6, 7
Test Port Output Low Voltage	V_{OLT}		0.4	V	6, 8

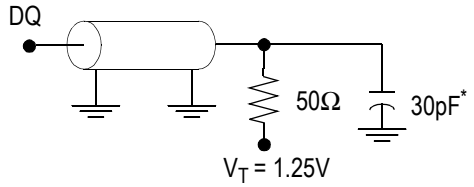
Note:
1. This device features input buffers compatible with 2.5V I/O drivers.
2. Input Under/overshoot voltage must be -2V > Vi < V_{DD}+2V with a pulse width not to exceed 20% tTKC.
3. $V_{DD} \geq V_{IN} \geq V_{IL}$
4. $0V \leq V_{IN} \leq V_{IL}$
5. Output Disable, V_{OUT} = 0 to V_{DD}
6. The TDO output driver is served by the VDD supply.
7. I_{OH} = - 4mA
8. I_{OL} = + 4mA

JTAG Port AC Test Conditions

Parameter	Conditions
Input high level	2.3V
Input low level	0.2V
Input slew rate	1V/ns
Input reference level	1.25V
Output reference level	1.25V

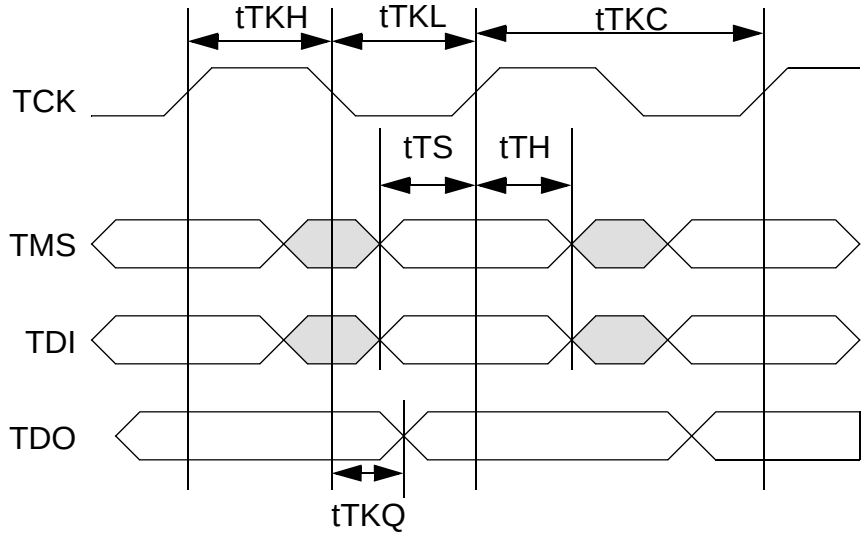
Notes:

JTAG Port AC Test Load



* Distributed Test Jig Capacitance

JTAG Port Timing Diagram



JTAG Port AC Electrical Characteristics

Parameter	Symbol	Min	Max	Unit
TCK Cycle Time	tTKC	20	-	ns
TCK Low to TDO Valid	tTKQ	-	10	ns
TCK High Pulse Width	tTKH	10	-	ns
TCK Low Pulse Width	tTKL	10	-	ns
TDI & TMS Set Up Time	tTS	5	-	ns
TDI & TMS Hold Time	tTH	5	-	ns

GS8161Z18/36T TQFP Boundary Scan Register

Order	x36	x18	Pin
1	PH = 0		n/a
2	PH = 0		n/a
3	A_{10}		44
4	A_{11}		45
5	A_{12}		46
6	A_{13}		47
7	A_{14}		48
8	A_{15}		49
9	A_{16}		50
10	x36 = DQ_{A9}	NC = 1	51
11	DQ_{A8}	NC = 1	52
12	DQ_{A7}	NC = 1	53
13	DQ_{A6}	NC = 1	56
14	DQ_{A5}	NC = 1	57
15	DQ_{A4}	DQ_{A1}	58
16	DQ_{A3}	DQ_{A2}	59
17	DQ_{A2}	DQ_{A3}	62
18	DQ_{A1}	DQ_{A4}	63
19	ZZ		64
21	DQ_{B1}	DQ_{A5}	68
22	DQ_{B2}	DQ_{A6}	69
23	DQ_{B3}	DQ_{A7}	72
24	DQ_{B4}	DQ_{A8}	73
25	DQ_{B5}	DQ_{A9}	74
26	DQ_{B6}	NC = 1	75
27	DQ_{B7}	NC = 1	78
28	DQ_{B8}	NC = 1	79
29	x36 = DQ_{B9}	A_{19}	80
30	A_9		81
31	A_8		82
32	A_{17}		83
33	A_{18}		84

Order	x36	x18	Pin
34	ADV		85
35	$\overline{G}$		86
36	$\overline{CKE}$		87
37	$\overline{W}$		88
38	CK		89
39	PH = 1		n/a
40	PH = 1		n/a
41	$\overline{E}_3$		92
42	$\overline{B}_A$		93
43	$\overline{B}_B$		94
44	$\overline{B}_C$	NC = 1	95
45	$\overline{B}_D$	NC = 1	96
46	E_2		97
47	$\overline{E}_1$		98
48	A_7		99
49	A_6		100
50	x36 = DQ_{C9}	NC = 1	1
51	DQ_{C8}	NC = 1	2
52	DQ_{C7}	NC = 1	3
53	DQ_{C6}	NC = 1	6
54	DQ_{C5}	NC = 1	7
55	DQ_{C4}	DQ_{B1}	8
56	DQ_{C3}	DQ_{B2}	9
57	DQ_{C2}	DQ_{B3}	12
58	DQ_{C1}	DQ_{B4}	13
59	$\overline{FT}$		14
60	DP		16
61	PH = 1		n/a
62	DQ_{D1}	DQ_{B5}	18
63	DQ_{D2}	DQ_{B6}	19
64	DQ_{D3}	DQ_{B7}	22
65	DQ_{D4}	DQ_{B8}	23

Order	x36	x18	Pin
66	DQ_{D5}	DQ_{B9}	24
67	DQ_{D6}	NC = 1	25
68	DQ_{D7}	NC = 1	28
69	DQ_{D8}	NC = 1	29
70	x36 = DQ_{D9}	NC = 1	30
71	$\overline{LBO}$		31
72	A5		32
73	A4		33
74	A3		34
75	A2		35
76	A1		36
77	A0		37
78	PH = 0		n/a

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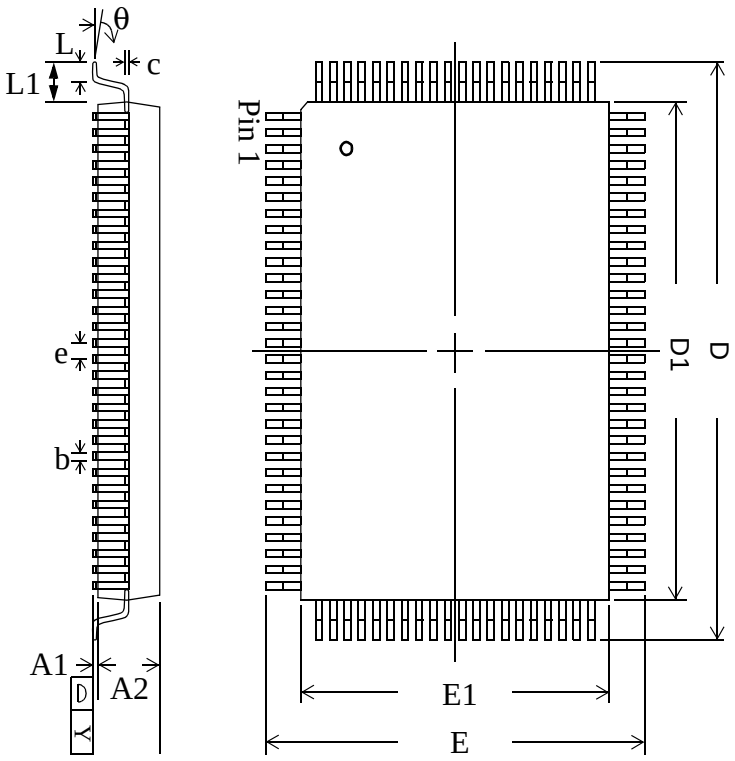
Note:
1. The Boundary Scan Register contains a number of registers that are not connected to any pin. They default to the value shown at reset.
2. Registers are listed in exit order (i.e. Location 1 is the first out of the TDO pin.
3. NC = No Connect, NA = Not Active, PH = Place Holder (No associated pin)

TQFP Package Drawing

Symbol	Description	Min.	Nom.	Max
A1	Standoff	0.05	0.10	0.15
A2	Body Thickness	1.35	1.40	1.45
b	Lead Width	0.20	0.30	0.40
c	Lead Thickness	0.09		0.20
D	Terminal Dimension	21.9	22.0	20.1
D1	Package Body	19.9	20.0	20.1
E	Terminal Dimension	15.9	16.0	16.1
E1	Package Body	13.9	14.0	14.1
e	Lead Pitch		0.65	
L	Foot Length	0.45	0.60	0.75
L1	Lead Length		1.00	
Y	Coplanarity			0.10
θ	Lead Angle	0°		7°



Notes:
1. All dimensions are in millimeters (mm).
2. Package width and length do not include mold protrusion

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Ordering Information - GSI NBT Synchronous SRAM

Org	Part Number[1]	Type	Package	Speed[2] (Mhz/ns)	T_A[3]	Status
1M x 18	GS8161Z18T-200	ByteSafe NBT Pipeline/Flow Through	TQFP	200/7.5	C	
1M x 18	GS8161Z18T-180	ByteSafe NBT Pipeline/Flow Through	TQFP	180/8	C	
1M x 18	GS8161Z18T-166	ByteSafe NBT Pipeline/Flow Through	TQFP	166/8.5	C	
1M x 18	GS8161Z18T-150	ByteSafe NBT Pipeline/Flow Through	TQFP	150/10	C	
1M x 18	GS8161Z18T-133	ByteSafe NBT Pipeline/Flow Through	TQFP	133/11	C	
512K x 36	GS8161Z36T-200	ByteSafe NBT Pipeline/Flow Through	TQFP	200/7.5	C	
512K x 36	GS8161Z36T-180	ByteSafe NBT Pipeline/Flow Through	TQFP	180/8	C	
512K x 36	GS8161Z36T-166	ByteSafe NBT Pipeline/Flow Through	TQFP	166/8.5	C	
512K x 36	GS8161Z36T-150	ByteSafe NBT Pipeline/Flow Through	TQFP	150/10	C	
512K x 36	GS8161Z36T-133	ByteSafe NBT Pipeline/Flow Through	TQFP	133/11	C	
1M x 18	GS8161Z18T-200I	ByteSafe NBT Pipeline/Flow Through	TQFP	200/7.5	I	Not Available
1M x 18	GS8161Z18T-180I	ByteSafe NBT Pipeline/Flow Through	TQFP	180/8	I	
1M x 18	GS8161Z18T-166I	ByteSafe NBT Pipeline/Flow Through	TQFP	166/8.5	I	
1M x 18	GS8161Z18T-150I	ByteSafe NBT Pipeline/Flow Through	TQFP	150/10	I	
1M x 18	GS8161Z18T-133I	ByteSafe NBT Pipeline/Flow Through	TQFP	133/11	I	
512K x 36	GS8161Z36T-200I	ByteSafe NBT Pipeline/Flow Through	TQFP	200/7.5	I	Not Available
512K x 36	GS8161Z36T-180I	ByteSafe NBT Pipeline/Flow Through	TQFP	180/8	I	
512K x 36	GS8161Z36T-166I	ByteSafe NBT Pipeline/Flow Through	TQFP	166/8.5	I	
512K x 36	GS8161Z36T-150I	ByteSafe NBT Pipeline/Flow Through	TQFP	150/10	I	
512K x 36	GS8161Z36T-133I	ByteSafe NBT Pipeline/Flow Through	TQFP	133/11	I	

Notes:

1. Customers requiring delivery in Tape and Reel should add the character T to the end of the part number. Example: GS8161Z36T-100IT.
2. The speed column indicates the cycle frequency (Mhz) of the device in Pipelined mode and the latency (ns) in Flow Through mode. Each device is Pipeline / Flow through mode selectable by the user T_A = C = Commercial Temperature Range. T_A = I = Industrial Temperature Range.
3. T_A = C = Commercial Temperature Range. T_A = I = Industrial Temperature Range.
4. GSI offers other versions this type of device in many different configurations and with a variety of different features, only some of which are covered in this data sheet. See the GSI Technology web site for a complete listing of current offerings

0.18u 16M Sync SRAM Data Sheet Revision History

DS/DateRev. Code: Old; New	Types of Changes Format or Content	Page;Revisions;Reason
GS8161Z18/36T 1.00 9/ 1999A;GS8161Z18/36T2.0012/ 1999B	Content	Converted from 0.25u 3.3V process to 0.18u 2.5V process. Master File Rev B Added x72 Pinout.
GS8161Z18/36T2.00 12/ 1999BGS8161Z18/36T2.01 1/ 2000C	Format	Added new GSI Logo
GS8161Z18/36T2.01 1/ 2000DGS8161Z18/36T2.03 2/ 2000E		Front page; Features - changed 2.5V I/O supply to 2.5V or3.3V I/O supply; Completeness Absolute Maximum Ratings; Changed VDDQ - Value: From: -.05 to VDD : to : -.05 to 3.6; Completeness. Recommended Operating Conditions;Changed: I/O Supply Voltage- Max. from VDD to 3.6; Input High Voltage- Max. from VDD +0.3 to 3.6; Same page - took out Note 1;Completeness Electrical Characteristics - Added second Output High Voltage line to table; completeness. Note: There was not a Rev 2.02 for the 8160Z or the 8161Z.
GS8161Z18/36T2.03 2/2000E; 8161Z18_r2_04	Content	Pin 14 removed from V_{SS} in pin description table. ADV changed to pin 85 in pin description table.
8161Z18_r2_04; 8161Z18_r2_05	Content	Changed the value of ZZ recovery in the AC Electrical Characteristics table on page 18 from 20 ns to 100 ns

