

100-Pin TQFP  
Commercial Temp  
Industrial Temp

**1M x 18, 512K x 32, 512K x 36**  
**18Mb Sync Burst SRAMs**

5.5 ns–8.5 ns  
2.5 V or 3.3 V  $V_{DD}$   
2.5 V or 3.3 V I/O

## Features

- Flow Through mode operation; Pin 14 = No Connect
- 2.5 V or 3.3 V +10%/–10% core power supply
- 2.5 V or 3.3 V I/O supply
- $\overline{LBO}$  pin for Linear or Interleaved Burst mode
- Internal input resistors on mode pins allow floating mode pins
- Byte Write ( $\overline{BW}$ ) and/or Global Write ( $\overline{GW}$ ) operation
- Internal self-timed write cycle
- Automatic power-down for portable applications
- JEDEC-standard 100-lead TQFP package

		-5.5	-6	-6.5	-7	-7.5	-8.5	Unit
<b>Flow Through 2-1-1-1</b>	$t_{KQ}$	5.5	6.0	6.5	7.0	7.5	8.5	ns
	$t_{Cycle}$	5.5	6.0	6.5	7.0	7.5	8.5	ns
<b>3.3 V</b>	Curr (x18)	175	165	160	150	145	135	mA
	Curr (x32/x36)	200	190	180	170	165	150	mA
<b>2.5 V</b>	Curr (x18)	175	165	160	150	145	135	mA
	Curr (x32/x36)	200	190	180	170	165	150	mA

## Functional Description

### Applications

The GS8160F18/32/36T is an 18,874,368-bit (16,777,216-bit for x32 version) high performance synchronous SRAM with a 2-bit burst address counter. Although of a type originally developed for Level 2 Cache applications supporting high performance CPUs, the device now finds application in synchronous SRAM applications, ranging from DSP main store to networking chip set support.

### Controls

Addresses, data I/Os, chip enables ( $\overline{E1}$ ,  $E2$ ,  $\overline{E3}$ ), address burst control inputs ( $\overline{ADSP}$ ,  $\overline{ADSC}$ ,  $\overline{ADV}$ ), and write control inputs ( $\overline{Bx}$ ,  $\overline{BW}$ ,  $\overline{GW}$ ) are synchronous and are controlled by a positive-edge-triggered clock input (CK). Output enable ( $\overline{G}$ ) and power down control (ZZ) are asynchronous inputs. Burst cycles can be initiated with either  $\overline{ADSP}$  or  $\overline{ADSC}$  inputs. In Burst mode, subsequent burst addresses are generated internally and are controlled by  $\overline{ADV}$ . The burst address counter may be configured to count in either linear or interleave order with the Linear Burst Order ( $\overline{LBO}$ ) input. The Burst function need not be used. New addresses can be loaded on every cycle with no degradation of chip performance.

### Designing For Compatibility

The JEDEC standard for Burst RAMS calls for a  $\overline{FT}$  mode pin

option on Pin 14. Board sites for flow through Burst RAMS should be designed with  $V_{SS}$  connected to the  $\overline{FT}$  pin location to ensure the broadest access to multiple vendor sources. Boards designed with  $\overline{FT}$  pin pads tied low may be stuffed with GSI's pipeline/flow through-configurable Burst RAMs or any vendor's flow through or configurable Burst SRAM. Boards designed with the  $\overline{FT}$  pin location tied high or floating must employ a non-configurable flow through Burst RAM, like this RAM, to achieve flow through functionality.

### Byte Write and Global Write

Byte write operation is performed by using Byte Write enable ( $\overline{BW}$ ) input combined with one or more individual byte write signals ( $\overline{Bx}$ ). In addition, Global Write ( $\overline{GW}$ ) is available for writing all bytes at one time, regardless of the Byte Write control inputs.

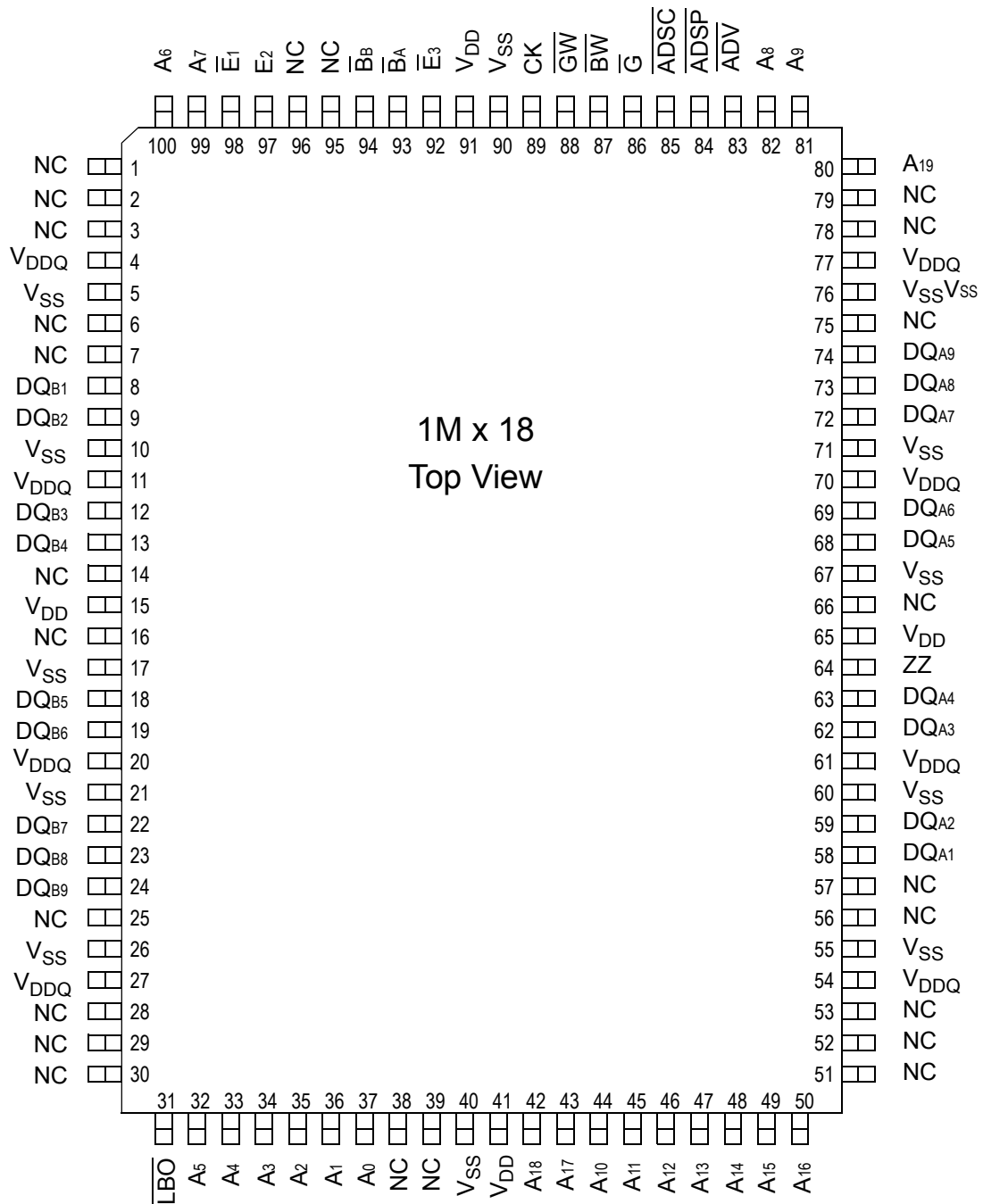
### Sleep Mode

Low power (Sleep mode) is attained through the assertion (High) of the ZZ signal, or by stopping the clock (CK). Memory data is retained during Sleep mode.

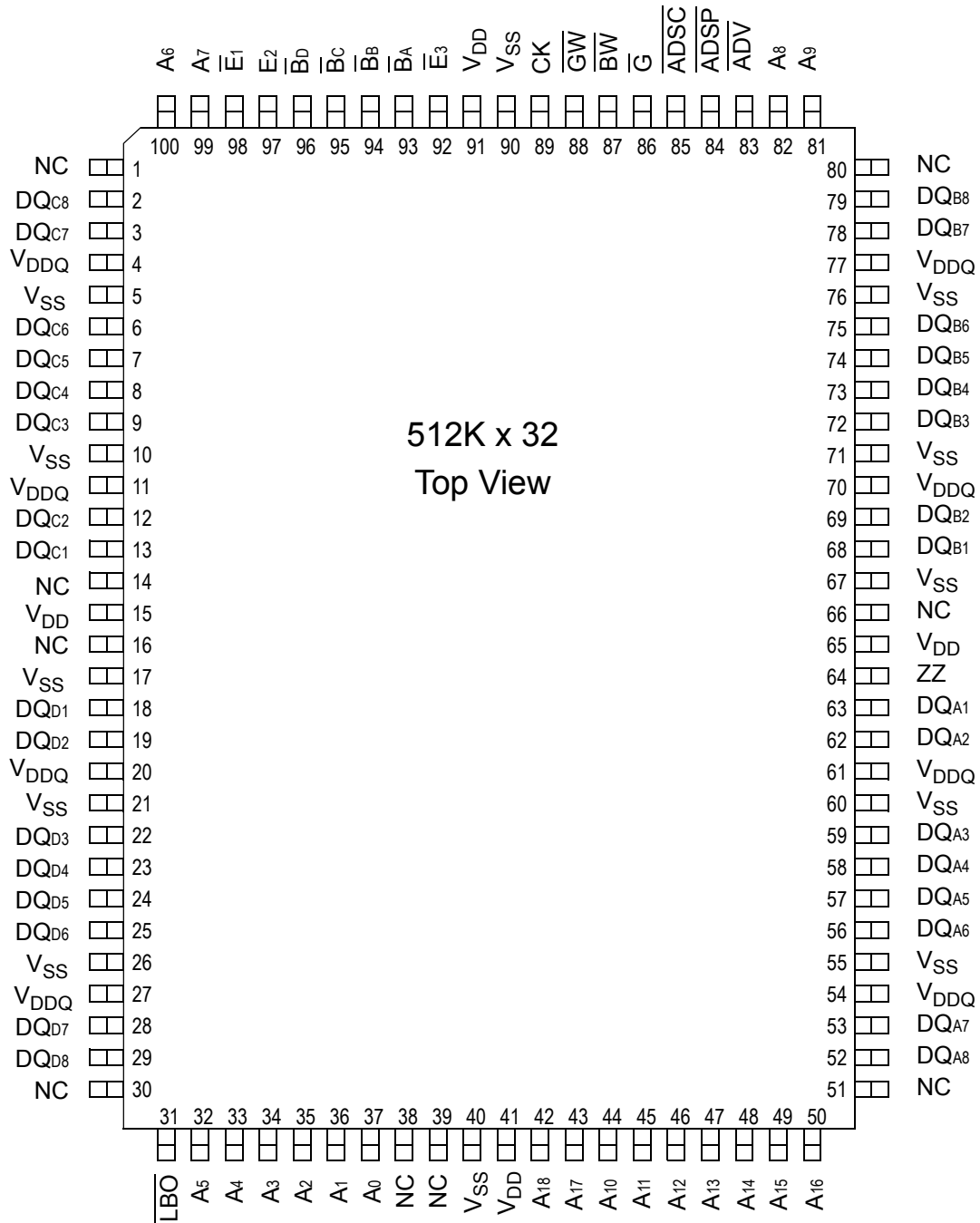
### Core and Interface Voltages

The GS8160F18/32/36T operates on a 2.5 V or 3.3 V power supply. All input are 3.3 V and 2.5 V compatible. Separate output power ( $V_{DDQ}$ ) pins are used to decouple output noise from the internal circuits and are 3.3 V and 2.5 V compatible.

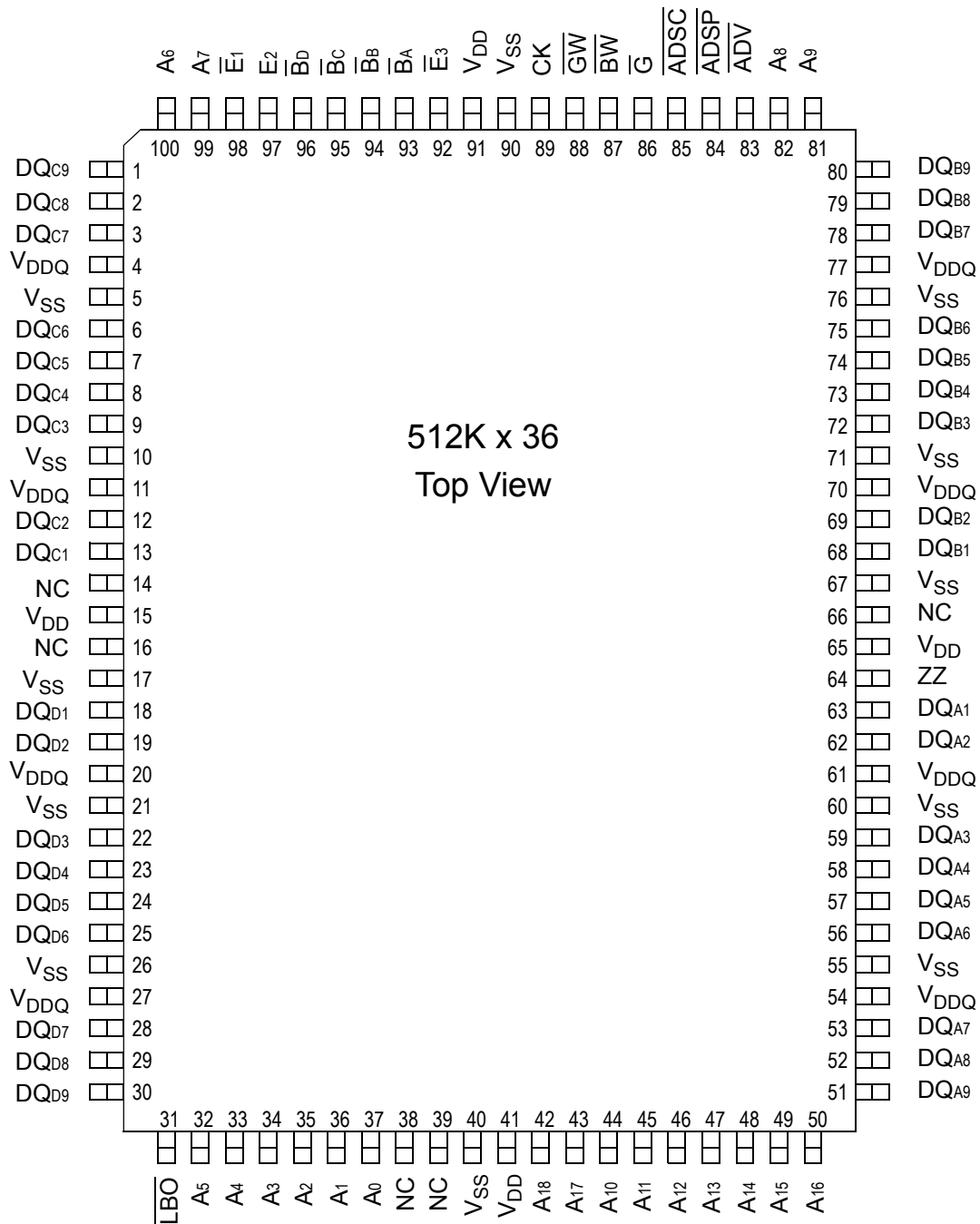
GS8160F18 100-Pin TQFP Pinout



GS8160F32 100-Pin TQFP Pinout



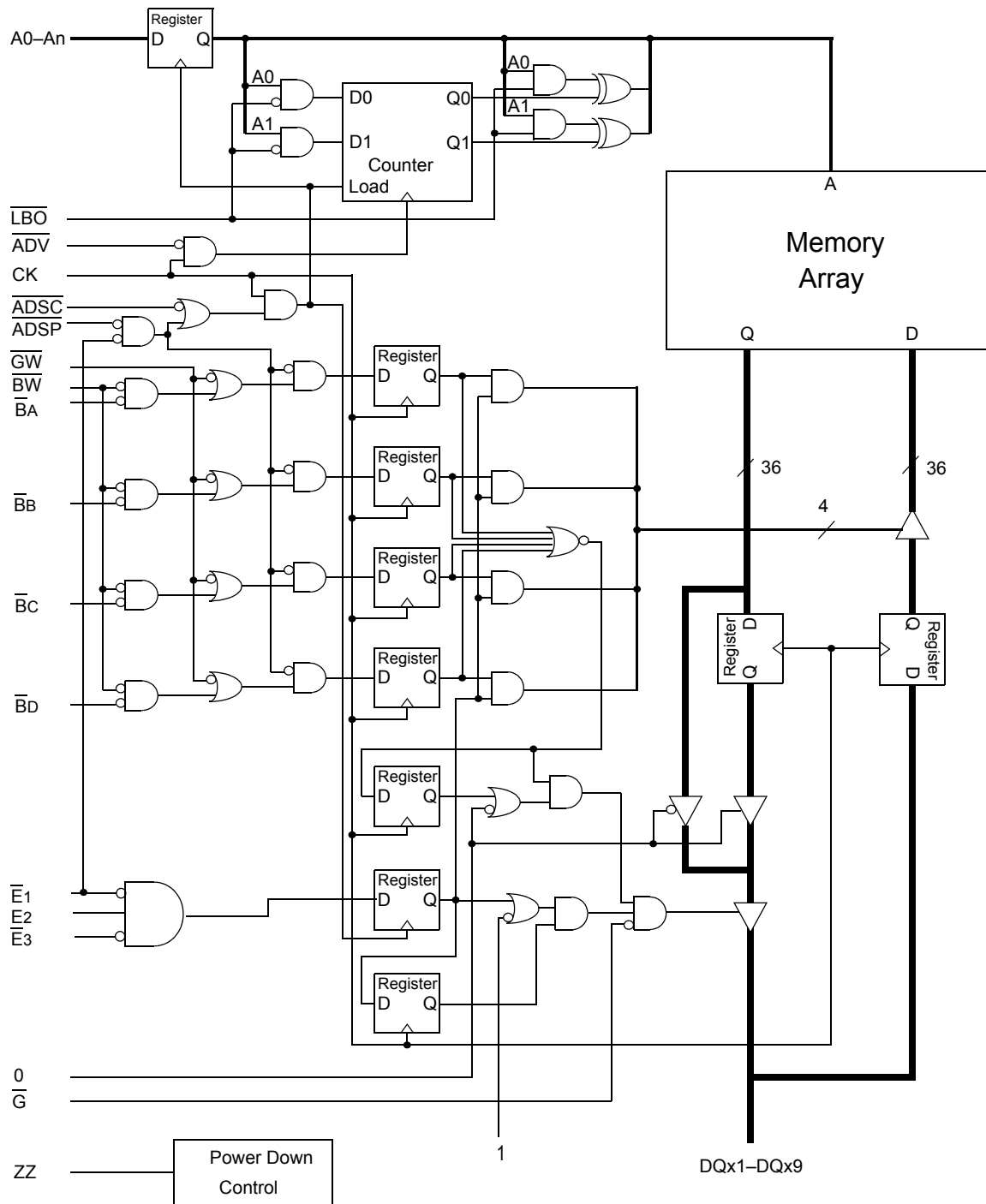
GS8160F36 100-Pin TQFP Pinout



**TQFP Pin Description**

Symbol	Type	Description
A <sub>0</sub> , A <sub>1</sub>	I	Address field LSBs and Address Counter preset Inputs
A <sub>2</sub> –A <sub>18</sub>	I	Address Inputs
A <sub>19</sub>	I	Address Input
DQ <sub>A1</sub> –DQ <sub>A9</sub> DQ <sub>B1</sub> –DQ <sub>B9</sub> DQ <sub>C1</sub> –DQ <sub>C9</sub> DQ <sub>D1</sub> –DQ <sub>D9</sub>	I/O	Data Input and Output pins
NC	—	No Connect
$\overline{BW}$	I	Byte Write—Writes all enabled bytes; active low
$\overline{BA}$ , $\overline{BB}$ , $\overline{BC}$ , $\overline{BD}$	I	Byte Write Enable for DQ <sub>A</sub> , DQ <sub>B</sub> Data I/Os; active low
CK	I	Clock Input Signal; active high
$\overline{GW}$	I	Global Write Enable—Writes all bytes; active low
$\overline{E}_1$ , $\overline{E}_3$	I	Chip Enable; active low
$\overline{E}_2$	I	Chip Enable; active high
$\overline{G}$	I	Output Enable; active low
$\overline{ADV}$	I	Burst address counter advance enable; active low
$\overline{ADSP}$ , $\overline{ADSC}$	I	Address Strobe (Processor, Cache Controller); active low
$\overline{ZZ}$	I	Sleep Mode control; active high
$\overline{LBO}$	I	Linear Burst Order mode; active low
V <sub>DD</sub>	I	Core power supply
V <sub>SS</sub>	I	I/O and Core Ground
V <sub>DDQ</sub>	I	Output driver power supply

GS8160F18/32/36 Block Diagram



Note: Only x36 version shown for simplicity.

**Mode Pin Functions**

Mode Name	Pin Name	State	Function
Burst Order Control	$\overline{\text{LBO}}$	L	Linear Burst
		H	Interleaved Burst
Power Down Control	ZZ	L or NC	Active
		H	Standby, $I_{DD} = I_{SB}$

Note:

There is a pull-down device on the ZZ pin, so this input pin 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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**Byte Write Truth Table**

Function	$\overline{\text{GW}}$	$\overline{\text{BW}}$	$\overline{\text{BA}}$	$\overline{\text{BB}}$	$\overline{\text{BC}}$	$\overline{\text{BD}}$	Notes
Read	H	H	X	X	X	X	1
Read	H	L	H	H	H	H	1
Write byte a	H	L	L	H	H	H	2, 3
Write byte b	H	L	H	L	H	H	2, 3
Write byte c	H	L	H	H	L	H	2, 3, 4
Write byte d	H	L	H	H	H	L	2, 3, 4
Write all bytes	H	L	L	L	L	L	2, 3, 4
Write all bytes	L	X	X	X	X	X	

Notes:

- All byte outputs are active in read cycles regardless of the state of Byte Write Enable inputs.
- Byte Write Enable inputs BA, BB, BC, and/or BD may be used in any combination with BW to write single or multiple bytes.
- All byte I/Os remain High-Z during all write operations regardless of the state of Byte Write Enable inputs.
- Bytes "c" and "d" are only available on the x32 and x36 versions.

**Synchronous Truth Table**

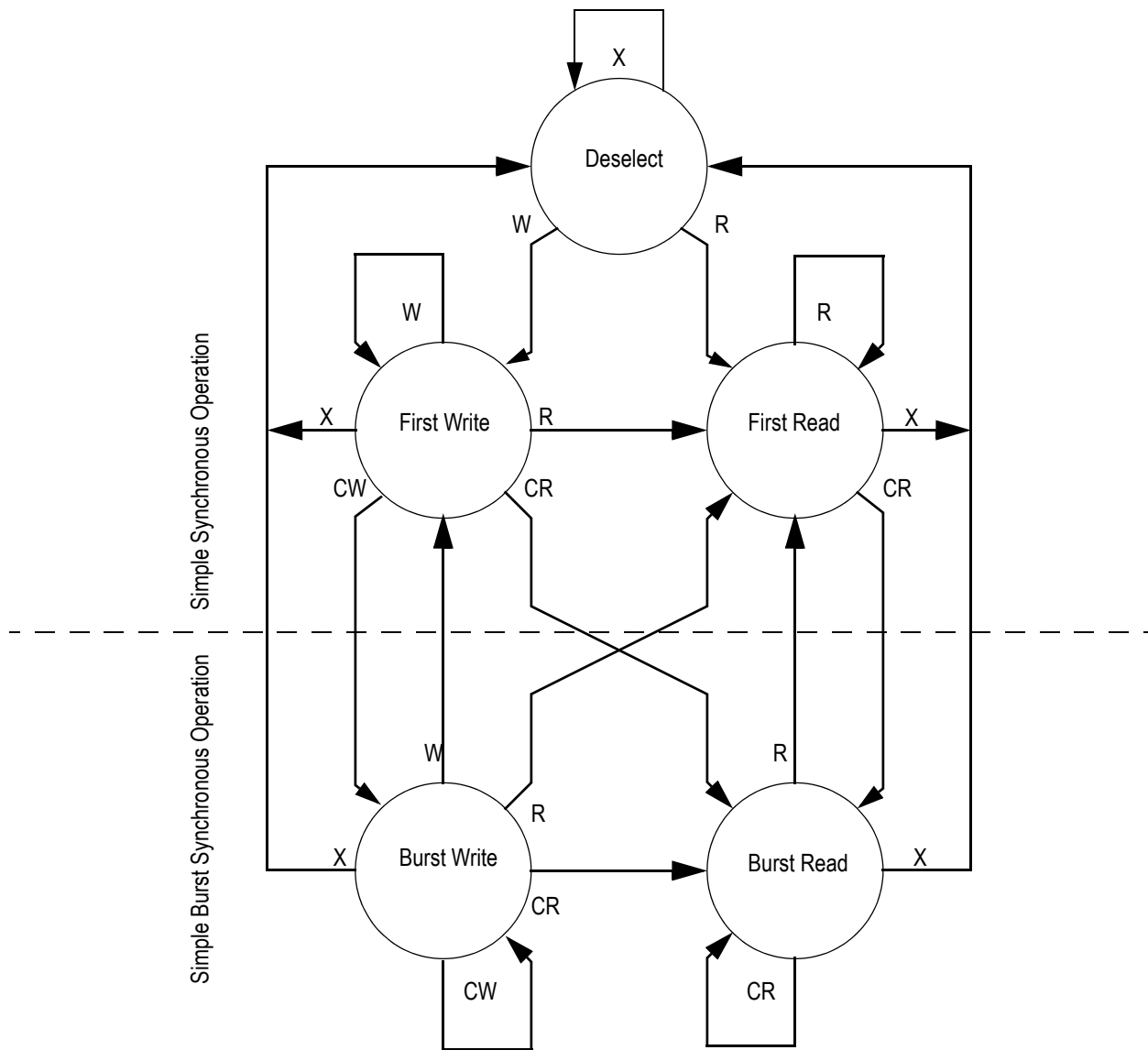
Operation	Address Used	State Diagram Key <sup>5</sup>	$\bar{E}_1$	$E^2$	$\overline{ADSP}$	$\overline{ADSC}$	$\overline{ADV}$	$\bar{W}^3$	DQ <sup>4</sup>
<b>Deselect Cycle, Power Down</b>	<b>None</b>	<b>X</b>	<b>H</b>	<b>X</b>	<b>X</b>	<b>L</b>	<b>X</b>	<b>X</b>	<b>High-Z</b>
Deselect Cycle, Power Down	None	X	L	F	L	X	X	X	High-Z
<b>Deselect Cycle, Power Down</b>	<b>None</b>	<b>X</b>	<b>L</b>	<b>F</b>	<b>H</b>	<b>L</b>	<b>X</b>	<b>X</b>	<b>High-Z</b>
Read Cycle, Begin Burst	External	R	L	T	L	X	X	X	Q
<b>Read Cycle, Begin Burst</b>	<b>External</b>	<b>R</b>	<b>L</b>	<b>T</b>	<b>H</b>	<b>L</b>	<b>X</b>	<b>F</b>	<b>Q</b>
<b>Write Cycle, Begin Burst</b>	<b>External</b>	<b>W</b>	<b>L</b>	<b>T</b>	<b>H</b>	<b>L</b>	<b>X</b>	<b>T</b>	<b>D</b>
<i>Read Cycle, Continue Burst</i>	<i>Next</i>	<i>CR</i>	<i>X</i>	<i>X</i>	<i>H</i>	<i>H</i>	<i>L</i>	<i>F</i>	<i>Q</i>
Read Cycle, Continue Burst	Next	CR	H	X	X	H	L	F	Q
<i>Write Cycle, Continue Burst</i>	<i>Next</i>	<i>CW</i>	<i>X</i>	<i>X</i>	<i>H</i>	<i>H</i>	<i>L</i>	<i>T</i>	<i>D</i>
Write Cycle, Continue Burst	Next	CW	H	X	X	H	L	T	D
Read Cycle, Suspend Burst	Current		X	X	H	H	H	F	Q
Read Cycle, Suspend Burst	Current		H	X	X	H	H	F	Q
Write Cycle, Suspend Burst	Current		X	X	H	H	H	T	D
Write Cycle, Suspend Burst	Current		H	X	X	H	H	T	D

## Notes:

1. X = Don't Care, H = High, L = Low
2. E = T (True) if  $E_2 = 1$ ; E = F (False) if  $E_2 = 0$
3.  $\bar{W} = T$  (True) and F (False) is defined in the Byte Write Truth Table preceding
4.  $\bar{G}$  is an asynchronous input.  $\bar{G}$  can be driven high at any time to disable active output drivers.  $\bar{G}$  low can only enable active drivers (shown as "Q" in the Truth Table above).
5. All input combinations shown above are tested and supported. Input combinations shown in gray boxes need not be used to accomplish basic synchronous or synchronous burst operations and may be avoided for simplicity.
6. Tying  $\overline{ADSP}$  high and  $\overline{ADSC}$  low allows simple non-burst synchronous operations. See **BOLD** items above.
7. Tying  $\overline{ADSP}$  high and  $\overline{ADV}$  low while using  $\overline{ADSC}$  to load new addresses allows simple burst operations. See *ITALIC* items above.

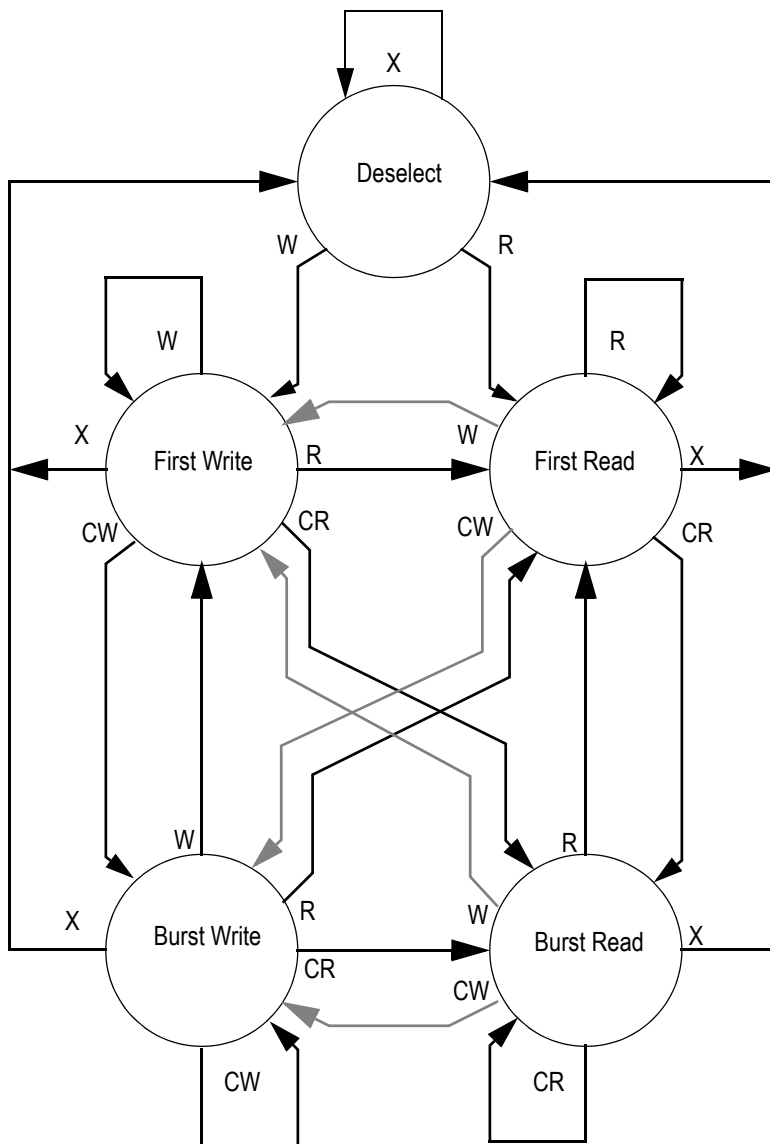


### Simplified State Diagram



Notes:

1. The diagram shows only supported (tested) synchronous state transitions. The diagram presumes  $\overline{G}$  is tied low.
2. The upper portion of the diagram assumes active use of only the Enable ( $\overline{E1}$ ,  $\overline{E2}$ , and  $\overline{E3}$ ) and Write ( $\overline{BA}$ ,  $\overline{BB}$ ,  $\overline{BC}$ ,  $\overline{BD}$ ,  $\overline{BW}$ , and  $\overline{GW}$ ) control inputs and that  $\overline{ADSP}$  is tied high and  $\overline{ADSC}$  is tied low.
3. The upper and lower portions of the diagram together assume active use of only the Enable, Write, and  $\overline{ADSC}$  control inputs and assumes  $\overline{ADSP}$  is tied high and  $\overline{ADV}$  is tied low.

Simplified State Diagram with  $\overline{G}$ 


## Notes:

1. The diagram shows supported (tested) synchronous state transitions plus supported transitions that depend upon the use of  $\overline{G}$ .
2. Use of "Dummy Reads" (Read Cycles with  $\overline{G}$  High) may be used to make the transition from read cycles to write cycles without passing through a Deselect cycle. Dummy Read cycles increment the address counter just like normal read cycles.
3. Transitions shown in grey tone assume  $\overline{G}$  has been pulsed high long enough to turn the RAM's drivers off and for incoming data to meet Data Input Set Up Time.

**Absolute Maximum Ratings**

 (All voltages reference to  $V_{SS}$ )

Symbol	Description	Value	Unit
$V_{DD}$	Voltage on $V_{DD}$ Pins	-0.5 to 4.6	V
$V_{DDQ}$	Voltage in $V_{DDQ}$ Pins	-0.5 to 4.6	V
$V_{CK}$	Voltage on Clock Input Pin	-0.5 to 6	V
$V_{I/O}$	Voltage on I/O Pins	-0.5 to $V_{DDQ} + 0.5$ ( $\leq 4.6$ V max.)	V
$V_{IN}$	Voltage on Other Input Pins	-0.5 to $V_{DD} + 0.5$ ( $\leq 4.6$ V max.)	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	$^{\circ}C$
$T_{BIAS}$	Temperature Under Bias	-55 to 125	$^{\circ}C$

**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.

**Power Supply Voltage Ranges**

Parameter	Symbol	Min.	Typ.	Max.	Unit	Notes
3.3 V Supply Voltage	$V_{DD3}$	3.0	3.3	3.6	V	
2.5 V Supply Voltage	$V_{DD2}$	2.3	2.5	2.7	V	
3.3 V $V_{DDQ}$ I/O Supply Voltage	$V_{DDQ3}$	3.0	3.3	3.6	V	
2.5 V $V_{DDQ}$ I/O Supply Voltage	$V_{DDQ2}$	2.3	2.5	2.7	V	

**Notes:**

- The part numbers 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.
- Input Under/overshoot voltage must be  $-2\text{ V} > V_i < V_{DDn} + 2\text{ V}$  not to exceed 4.6 V maximum, with a pulse width not to exceed 20% tKC.

 **$V_{DDQ3}$  Range Logic Levels**

Parameter	Symbol	Min.	Typ.	Max.	Unit	Notes
$V_{DD}$ Input High Voltage	$V_{IH}$	2.0	—	$V_{DD} + 0.3$	V	1
$V_{DD}$ Input Low Voltage	$V_{IL}$	-0.3	—	0.8	V	1
$V_{DDQ}$ I/O Input High Voltage	$V_{IHQ}$	2.0	—	$V_{DDQ} + 0.3$	V	1,3
$V_{DDQ}$ I/O Input Low Voltage	$V_{ILQ}$	-0.3	—	0.8	V	1,3

**Notes:**

- The part numbers 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.
- Input Under/overshoot voltage must be  $-2\text{ V} > V_i < V_{DDn} + 2\text{ V}$  not to exceed 4.6 V maximum, with a pulse width not to exceed 20% tKC.
- $V_{IHQ}$  (max) is voltage on  $V_{DDQ}$  pins plus 0.3 V.

 **$V_{DDQ2}$  Range Logic Levels**

Parameter	Symbol	Min.	Typ.	Max.	Unit	Notes
$V_{DD}$ Input High Voltage	$V_{IH}$	$0.6 * V_{DD}$	—	$V_{DD} + 0.3$	V	1
$V_{DD}$ Input Low Voltage	$V_{IL}$	-0.3	—	$0.3 * V_{DD}$	V	1
$V_{DDQ}$ I/O Input High Voltage	$V_{IHQ}$	$0.6 * V_{DD}$	—	$V_{DDQ} + 0.3$	V	1,3
$V_{DDQ}$ I/O Input Low Voltage	$V_{ILQ}$	-0.3	—	$0.3 * V_{DD}$	V	1,3

**Notes:**

- The part numbers 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.
- Input Under/overshoot voltage must be  $-2\text{ V} > V_i < V_{DDn} + 2\text{ V}$  not to exceed 4.6 V maximum, with a pulse width not to exceed 20% tKC.
- $V_{IHQ}$  (max) is voltage on  $V_{DDQ}$  pins plus 0.3 V.

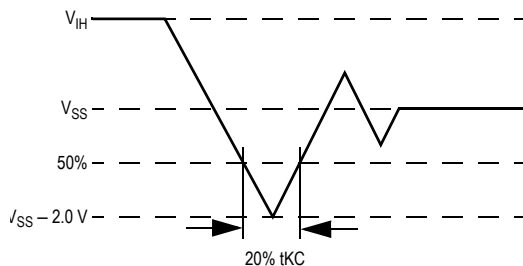
### Recommended Operating Temperatures

Parameter	Symbol	Min.	Typ.	Max.	Unit	Notes
Ambient Temperature (Commercial Range Versions)	$T_A$	0	25	70	°C	2
Ambient Temperature (Industrial Range Versions)	$T_A$	-40	25	85	°C	2

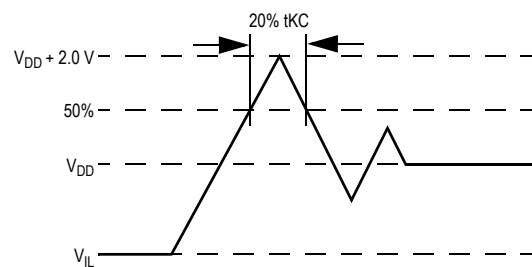
Note:

- The part numbers 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.
- Input Under/overshoot voltage must be  $-2\text{ V} > V_i < V_{DDn} + 2\text{ V}$  not to exceed 4.6 V maximum, with a pulse width not to exceed 20% tKC.

### Undershoot Measurement and Timing



### Overshoot Measurement and Timing



### Capacitance

( $T_A = 25^\circ\text{C}$ ,  $f = 1\text{ MHz}$ ,  $V_{DD} = 2.5\text{ V}$ )

Parameter	Symbol	Test conditions	Typ.	Max.	Unit
Input Capacitance	$C_{IN}$	$V_{IN} = 0\text{ V}$	4	5	pF
Input/Output Capacitance	$C_{I/O}$	$V_{OUT} = 0\text{ V}$	6	7	pF

Note: These parameters are 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:

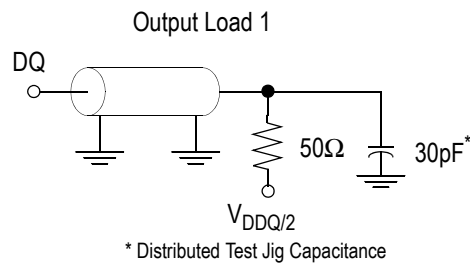
- Junction temperature is a function of SRAM power dissipation, package thermal resistance, mounting board temperature, ambient. Temperature air flow, board density, and PCB thermal resistance.
- SCMI G-38-87
- Average thermal resistance between die and top surface, MIL SPEC-883, Method 1012.1

**AC Test Conditions**

Parameter	Conditions
Input high level	$V_{DD} - 0.2 V$
Input low level	0.2 V
Input slew rate	1 V/ns
Input reference level	$V_{DD}/2$
Output reference level	$V_{DDQ}/2$
Output load	<b>Fig. 1</b>

Notes:

1. Include scope and jig capacitance.
2. Test conditions as specified with output loading as shown in Fig. 1 unless otherwise noted.
3. Device is deselected as defined by the Truth Table.


**DC Electrical Characteristics**

Parameter	Symbol	Test Conditions	Min	Max
Input Leakage Current (except mode pins)	$I_{IL}$	$V_{IN} = 0 \text{ to } V_{DD}$	-1 $\mu\text{A}$	1 $\mu\text{A}$
ZZ Input Current	$I_{IN1}$	$V_{DD} \geq V_{IN} \geq V_{IH}$ $0 V \leq V_{IN} \leq V_{IH}$	-1 $\mu\text{A}$ -1 $\mu\text{A}$	1 $\mu\text{A}$ 100 $\mu\text{A}$
$\overline{\text{FT}}$ Input Current	$I_{IN2}$	$V_{DD} \geq V_{IN} \geq V_{IL}$ $0 V \leq V_{IN} \leq V_{IL}$	-100 $\mu\text{A}$ -1 $\mu\text{A}$	1 $\mu\text{A}$ 1 $\mu\text{A}$
Output Leakage Current	$I_{OL}$	Output Disable, $V_{OUT} = 0 \text{ to } V_{DD}$	-1 $\mu\text{A}$	1 $\mu\text{A}$
Output High Voltage	$V_{OH2}$	$I_{OH} = -8 \text{ mA}$ , $V_{DDQ} = 2.375 \text{ V}$	1.7 V	—
Output High Voltage	$V_{OH3}$	$I_{OH} = -8 \text{ mA}$ , $V_{DDQ} = 3.135 \text{ V}$	2.4 V	—
Output Low Voltage	$V_{OL}$	$I_{OL} = 8 \text{ mA}$	—	0.4 V

**Operating Currents**

Parameter	Test Conditions	Mode	Symbol	-5.5		-6		-6.5		-7		-7.5		-8.5		Unit
				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	0 to 70°C	-40 to 85°C	
Operating Current <b>3.3 V</b>	Device Selected; All other inputs $\geq V_{IH}$ or $\leq V_{IL}$ Output open	(x36/ x32)	$I_{DD}$	180	190	170	180	165	175	155	165	150	160	140	150	mA
		Through	$I_{DDQ}$	20	20	20	20	15	15	15	15	15	15	10	10	
Operating Current <b>2.5 V</b>	Device Selected; All other inputs $\geq V_{IH}$ or $\leq V_{IL}$ Output open	(x36/ x32)	$I_{DD}$	180	190	170	180	165	175	155	165	150	160	140	150	mA
		Through	$I_{DDQ}$	20	20	20	20	15	15	15	15	10	10	10	10	
Standby Current	$ZZ \geq V_{DD} - 0.2 V$		$I_{SB}$	20	30	20	30	20	30	20	30	20	30	20	30	mA
Deselect Current	Device Deselected; All other inputs $\geq V_{IH}$ or $\leq V_{IL}$		$I_{DD}$	60	65	50	55	50	55	50	55	50	55	45	50	mA

**Notes:**

- $I_{DD}$  and  $I_{DDQ}$  apply to any combination of  $V_{DD3}$ ,  $V_{DD2}$ ,  $V_{DDQ3}$ , and  $V_{DDQ2}$  operation.
- All parameters listed are worst case scenario.

**AC Electrical Characteristics**

	Parameter	Symbol	-5.5		-6		-6.5		-7		-7.5		-8.5		Unit
			Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	
<b>Flow Through</b>	Clock Cycle Time	t <sub>KC</sub>	5.5	—	6.0	—	6.5	—	7.0	—	7.5	—	8.5	—	ns
	Clock to Output Valid	t <sub>KQ</sub>	—	5.5	—	6.0	—	6.5	—	7.0	—	7.5	—	8.5	ns
	Clock to Output Invalid	t <sub>KQX</sub>	3.0	—	3.0	—	3.0	—	3.0	—	3.0	—	3.0	—	ns
	Clock to Output in Low-Z	t <sub>LZ</sub> <sup>1</sup>	3.0	—	3.0	—	3.0	—	3.0	—	3.0	—	3.0	—	ns
	Setup time	t <sub>S</sub>	1.5	—	1.5	—	1.5	—	1.5	—	1.5	—	1.5	—	ns
	Hold time	t <sub>H</sub>	0.5	—	0.5	—	0.5	—	0.5	—	0.5	—	0.5	—	ns
	Clock HIGH Time	t <sub>KH</sub>	1.3	—	1.3	—	1.3	—	1.3	—	1.5	—	1.7	—	ns
	Clock LOW Time	t <sub>KL</sub>	1.5	—	1.5	—	1.5	—	1.5	—	1.7	—	2	—	ns
	Clock to Output in High-Z	t <sub>HZ</sub> <sup>1</sup>	1.5	2.3	1.5	2.5	1.5	3.0	1.5	3.0	1.5	3.0	1.5	3.0	ns
	$\bar{G}$ to Output Valid	t <sub>OE</sub>	—	2.3	—	2.5	—	3.2	—	3.5	—	3.8	—	4.0	ns
	$\bar{G}$ to output in Low-Z	t <sub>OLZ</sub> <sup>1</sup>	0	—	0	—	0	—	0	—	0	—	0	—	ns
	$\bar{G}$ to output in High-Z	t <sub>OHZ</sub> <sup>1</sup>	—	2.3	—	2.5	—	3.0	—	3.0	—	3.0	—	3.0	ns
	ZZ setup time	t <sub>ZZS</sub> <sup>2</sup>	5	—	5	—	5	—	5	—	5	—	5	—	ns
	ZZ hold time	t <sub>ZZH</sub> <sup>2</sup>	1	—	1	—	1	—	1	—	1	—	1	—	ns
ZZ recovery	t <sub>ZZR</sub>	20	—	20	—	20	—	20	—	20	—	20	—	ns	

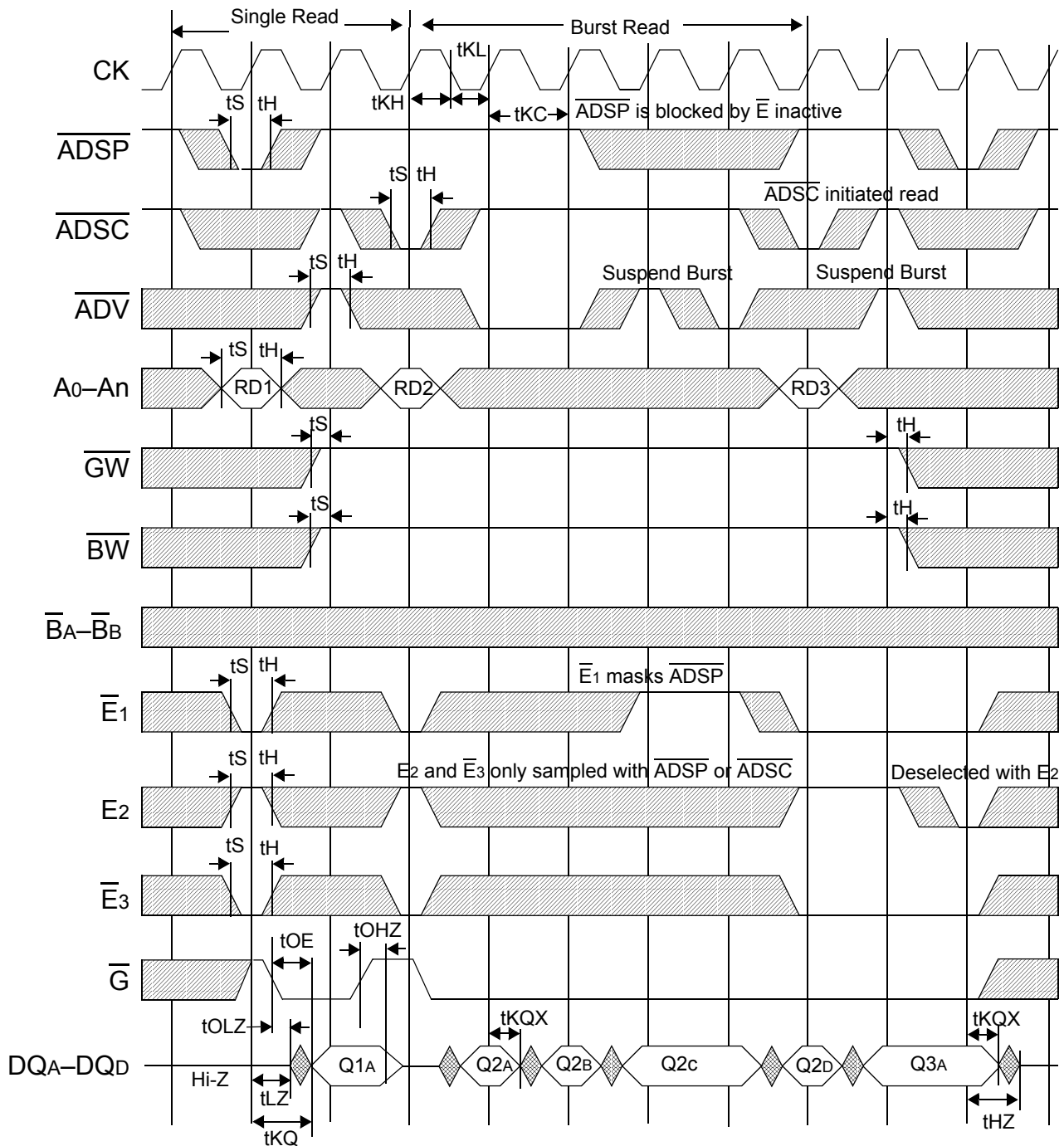
**Notes:**

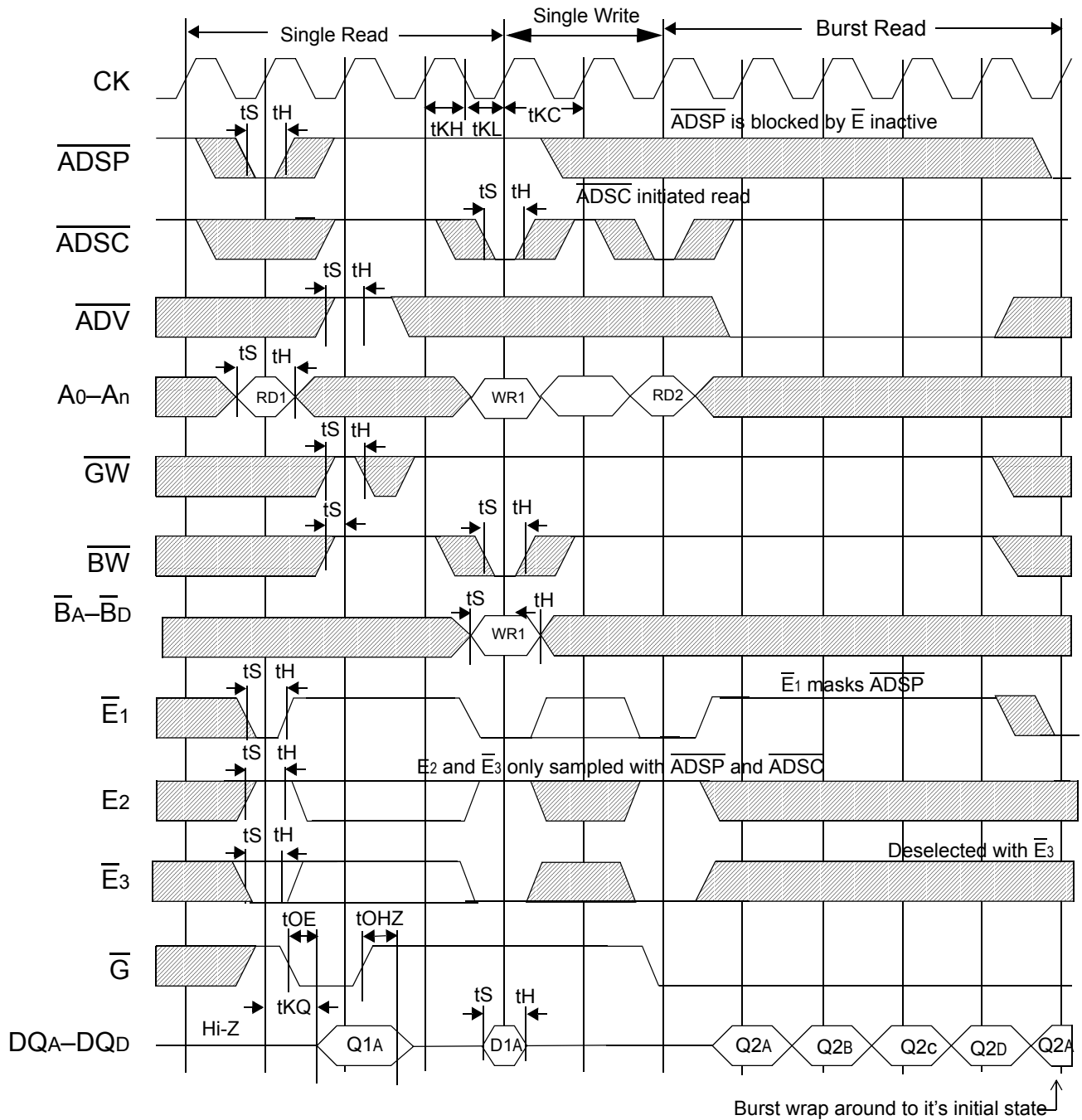
1. These parameters are sampled and are not 100% tested.
2. ZZ is an asynchronous signal. However, In order to be recognized on any given clock cycle, ZZ must meet the specified setup and hold times as specified above.





## Flow Through Read Cycle Timing



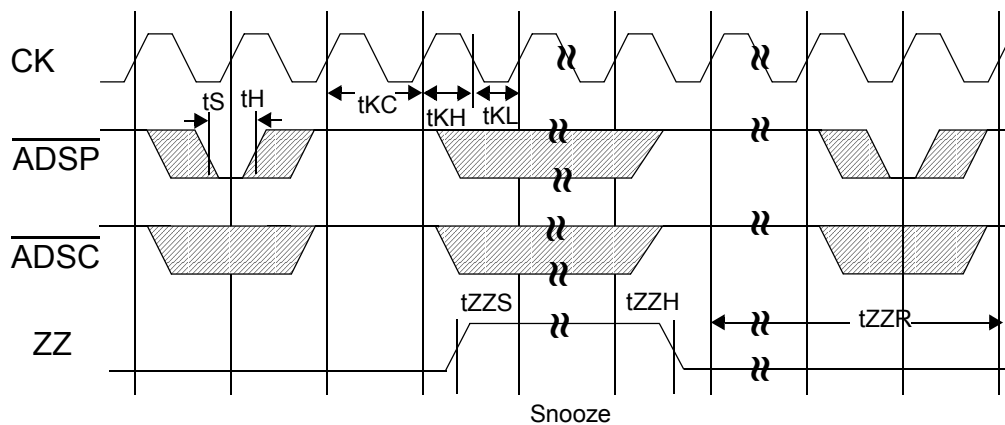
**Flow Through Read-Write Cycle Timing**


### Sleep Mode

During normal operation, ZZ must be pulled low, either by the user or by its 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 ZZ recovery time.

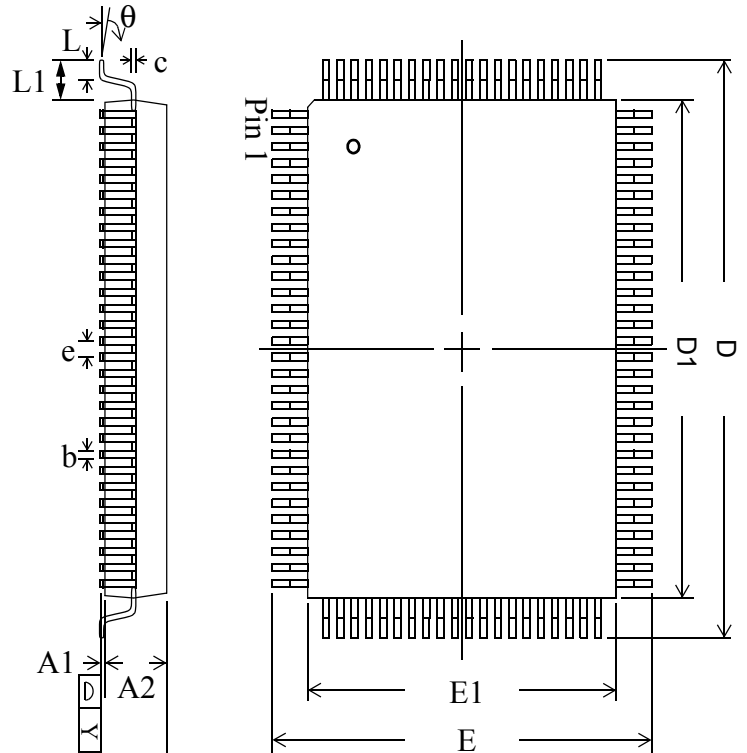
Sleep mode is a low current, power-down mode in which the device is deselected and current is reduced to  $I_{SB2}$ . The duration of Sleep mode is dictated by the length of time the ZZ is in a High state. After entering Sleep mode, all inputs except ZZ become disabled and all outputs go to High-Z. The ZZ pin is an asynchronous, active high input that causes the device to enter Sleep mode. When the ZZ pin is driven high,  $I_{SB2}$  is guaranteed after the time  $t_{ZZI}$  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  $t_{ZZR}$ , only a Deselect or Read commands may be applied while the SRAM is recovering from Sleep mode.

### Sleep Mode Timing Diagram



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	22.1
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
$\theta$	Lead Angle	0°	—	7°



Notes:

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

**Ordering Information for GSI Synchronous Burst RAMs**

Org	Part Number <sup>1</sup>	Type	Package	Speed <sup>2</sup> (MHz/ns)	T <sub>A</sub> <sup>3</sup>	Status
1M x 18	GS8160F18T-5.5	Flow Through	TQFP	5.5	C	
1M x 18	GS8160F18T-6	Flow Through	TQFP	6	C	
1M x 18	GS8160F18T-6.5	Flow Through	TQFP	6.5	C	
1M x 18	GS8160F18T-7	Flow Through	TQFP	7	C	
1M x 18	GS8160F18T-7.5	Flow Through	TQFP	7.5	C	
1M x 18	GS8160F18T-8.5	Flow Through	TQFP	8.5	C	
512K x 32	GS8160F32T-5.5	Flow Through	TQFP	5.5	C	
512K x 32	GS8160F32T-6	Flow Through	TQFP	6	C	
512K x 32	GS8160F32T-6.5	Flow Through	TQFP	6.5	C	
512K x 32	GS8160F32T-7	Flow Through	TQFP	7	C	
512K x 32	GS8160F32T-7.5	Flow Through	TQFP	7.5	C	
512K x 32	GS8160F32T-8.5	Flow Through	TQFP	8.5	C	
512K x 36	GS8160F36T-5.5	Flow Through	TQFP	5.5	C	
512K x 36	GS8160F36T-6	Flow Through	TQFP	6	C	
512K x 36	GS8160F36T-6.5	Flow Through	TQFP	6.5	C	
512K x 36	GS8160F36T-7	Flow Through	TQFP	7	C	
512K x 36	GS8160F36T-7.5	Flow Through	TQFP	7.5	C	
512K x 36	GS8160F36T-8.5	Flow Through	TQFP	8.5	C	
1M x 18	GS8160F18T-5.5I	Flow Through	TQFP	5.5	I	Not Available
1M x 18	GS8160F18T-6I	Flow Through	TQFP	6	I	Not Available
1M x 18	GS8160F18T-6.5I	Flow Through	TQFP	6.5	I	Not Available
1M x 18	GS8160F18T-7I	Flow Through	TQFP	7	I	
1M x 18	GS8160F18T-7.5I	Flow Through	TQFP	7.5	I	
1M x 18	GS8160F18T-8.5I	Flow Through	TQFP	8.5	I	
512K x 32	GS8160F32T-5.5I	Flow Through	TQFP	5.5	I	Not Available
512K x 32	GS8160F32T-6I	Flow Through	TQFP	6	I	Not Available
512K x 32	GS8160F32T-6.5I	Flow Through	TQFP	6.5	I	Not Available
512K x 32	GS8160F32T-7I	Flow Through	TQFP	7	I	
512K x 32	GS8160F32T-7.5I	Flow Through	TQFP	7.5	I	
512K x 32	GS8160F32T-8.5I	Flow Through	TQFP	8.5	I	

**Notes:**

- Customers requiring delivery in Tape and Reel should add the character "T" to the end of the part number. Example: GS8160F18-6T.
- The speed column indicates the cycle frequency (MHz) of the device in Pipeline mode and the latency (ns) in Flow Through mode. Each device is Pipeline/Flow through mode-selectable by the user.
- T<sub>A</sub> = C = Commercial Temperature Range. T<sub>A</sub> = I = Industrial Temperature Range.
- 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 ([www.gsistechnology.com](http://www.gsistechnology.com)) for a complete listing of current offerings.

Org	Part Number <sup>1</sup>	Type	Package	Speed <sup>2</sup> (MHz/ns)	T <sub>A</sub> <sup>3</sup>	Status
512K x 36	GS8160F36T-5.5I	Flow Through	TQFP	5.5	I	Not Available
512K x 36	GS8160F36T-6I	Flow Through	TQFP	6	I	Not Available
512K x 36	GS8160F36T-6.5I	Flow Through	TQFP	6.5	I	Not Available
512K x 36	GS8160F36T-7I	Flow Through	TQFP	7	I	
512K x 36	GS8160F36T-7.5I	Flow Through	TQFP	7.5	I	
512K x 36	GS8160F36T-8.5I	Flow Through	TQFP	8.5	I	

**Notes:**

1. Customers requiring delivery in Tape and Reel should add the character "T" to the end of the part number. Example: GS8160F18-6T.
2. The speed column indicates the cycle frequency (MHz) of the device in Pipeline mode and the latency (ns) in Flow Through mode. Each device is Pipeline/Flow through mode-selectable by the user.
3. T<sub>A</sub> = C = Commercial Temperature Range. T<sub>A</sub> = 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 ([www.gsitechnology.com](http://www.gsitechnology.com)) for a complete listing of current offerings.

**18Mb Sync SRAM Datasheet Revision History**

DS/DateRev. Code: Old; New	Types of Changes Format or Content	Page;Revisions;Reason
GS8160F18-8T 1.00 9/ 1999A;GS8160F18-8T 2.00 1/1999B	Content	<ul style="list-style-type: none"> <li>• Converted from 0.25u 3.3V process to 0.18u 2.5V process. Master File Rev B</li> <li>• Added x72 Pinout.</li> <li>• Added GSI Logo.</li> </ul>
GS8160F18- 2.00 11/ 1999B;GS8160F18 2.01 1/ 2000C	Format	<ul style="list-style-type: none"> <li>• Changed Flow-Through Read-Write cycle Timing Diagram for accuracy</li> </ul>
GS8160F18 2.01 1/ 2000C;GS8160F18 2.02 1/ 2000D		<ul style="list-style-type: none"> <li>• Changed pin description in TQFP to match order of pins in pinout.</li> </ul>
GS18/362.0 1/2000DGS18/ 362.03 2/2000E		<ul style="list-style-type: none"> <li>• Front page; Features - changed 2.5V I/O supply to 2.5V or 3.3V I/O supply; Core and Interface voltages - Changed paragraph to include information for 3.3V;Completeness</li> <li>• Absolute Maximum Ratings; Changed VDDQ - Value: From: - .05 to VDD : to : -.05 to 3.6; Completeness.</li> <li>• 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</li> <li>• Electrical Characteristics - Added second Output High Voltage line to table; completeness.</li> <li>• Note: There was not a Rev 2.02 for the 8160Z or the 8161Z.</li> </ul>
GS18/362.03 2/2000E; 8160F18_r2_04	Content	<ul style="list-style-type: none"> <li>• Changed the value of ZZ recovery in the AC Electrical Characteristics table on page 14 from 20 ns to 100 ns</li> </ul>
8160F18_r2_04; 8160F18_r2_05	Content/Format	<ul style="list-style-type: none"> <li>• Added 7 ns speed bin</li> <li>• Updated numbers in page 1 table, AC Characteristics table, and Operating Currents table</li> <li>• Updated format to comply with Technical Publications standards</li> <li>• Updated Capacitance table—removed Input row and changed Output row to I/O</li> </ul>
8160F18_r2_05; 8160F18_r2_06	Content	<ul style="list-style-type: none"> <li>• Updated Features list on page 1</li> <li>• Completely reworked table on page 1</li> <li>• Updated Mode Pin Functions table on page 7</li> </ul>
8160F18_r2_06; 8160F18_r2_07	Content	<ul style="list-style-type: none"> <li>• Added 3.3 V references to entire document</li> <li>• Updated Operating Conditions table</li> <li>• Added Pin 56 to Pin Description table</li> <li>• Updated Operating Currents table and added note</li> <li>• Updated table on page 1; added power numbers</li> </ul>
8160F18_r2_07; 8160F18_r2_08	Content	<ul style="list-style-type: none"> <li>• Updated Operating Currents table</li> <li>• Updated table on page 1; updated power numbers</li> </ul>



**18Mb Sync SRAM Datasheet Revision History**

DS/DateRev. Code: Old; New	Types of Changes Format or Content	Page;Revisions;Reason
8160F18_r2_08; 8160F18_r2_09	Content	<ul style="list-style-type: none"> <li>• Updated table on page 1</li> <li>• Created recommended operating conditions tables on pages 11 and 12</li> <li>• Updated AC Electrical Characteristics table</li> <li>• Added Sleep mode description on page 20</li> <li>• Updated Ordering Information for 7 ns part (changed from 7ns to 6.5 ns)</li> <li>• Added 6 ns speed bin</li> <li>• Deleted 8 ns speed bin</li> </ul>
8160F18_r2_09; 8160F18_r2_10	Content	<ul style="list-style-type: none"> <li>• Updated AC Characteristics table</li> <li>• Updated FT power numbers</li> <li>• Updated ZZ recovery time diagram</li> <li>• Updated Mb references from 16Mb to 18Mb</li> <li>• Updated AC Test Conditions table and removed Output Load 2 diagram</li> </ul>
8160F18_r2_10; 8160F18_r2_11	Content	<ul style="list-style-type: none"> <li>• Removed Preliminary banner</li> <li>• Removed pin locations from pin description table</li> </ul>