
HM62G18256 Series

4M Synchronous Fast Static RAM
(256k-words x 18-bits)

HITACHI

ADE-203-1007(Z)
Preliminary, Rev. 0.0
Feb. 5, 1999

Features

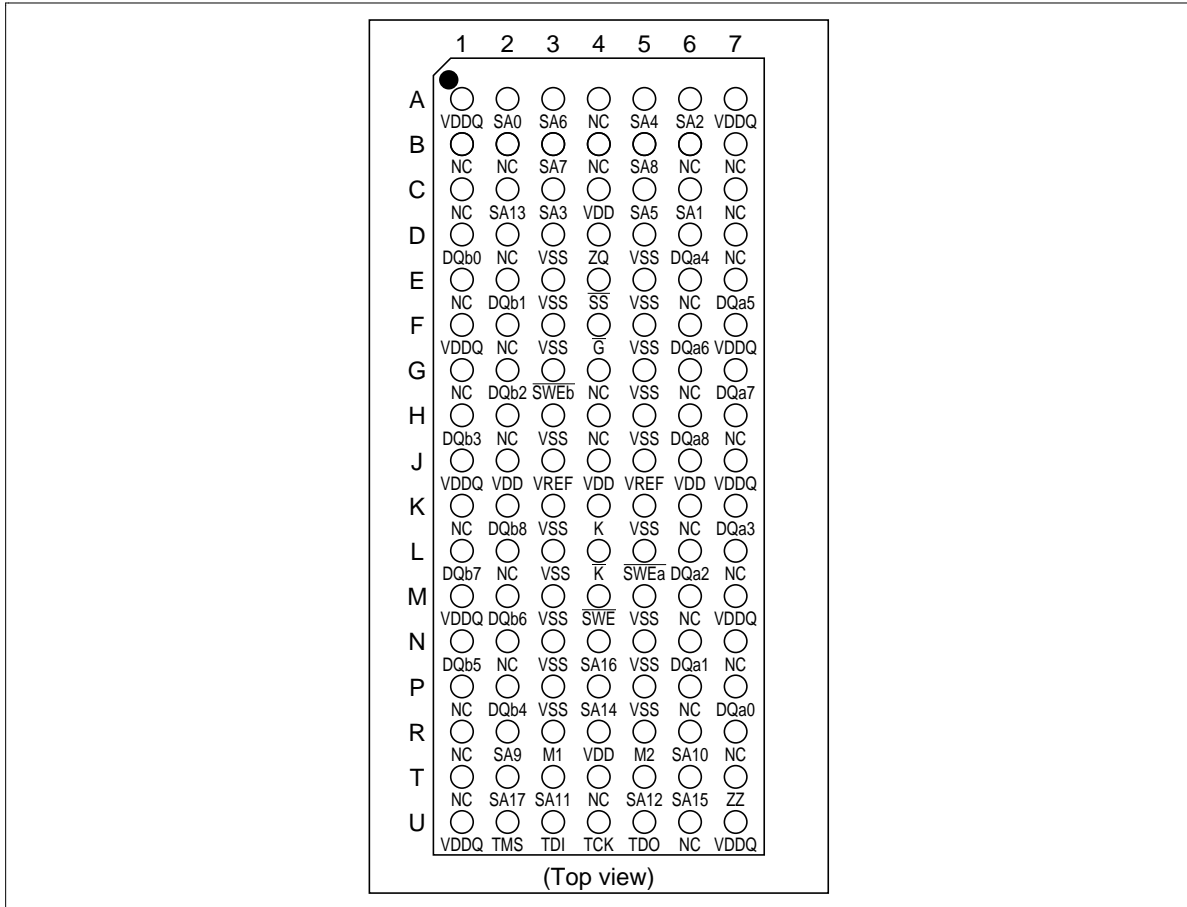
- 3.3V+10%, -5% Operation
- 4M bit density
- 200MHz - 250MHz frequency
- Synchronous Operation
- Internal self-timed Late Write
- Byte Write Control
(2byte write selects, one for each 9 bits)
- Optional x 36 configuration
- HSTL compatible I/O
- Programmable impedance output drivers
- User selective input trip - point
- Differential , HSTL Clock Inputs
- Asynchronous \overline{G} Output Control
- Asynchronous sleep mode
- BGA 119pin Package
- Limited set of boundary scan JTAG IEEE 1149.1 compatible
- Protocol : Single Clock Register-Register Mode

Ordering Information

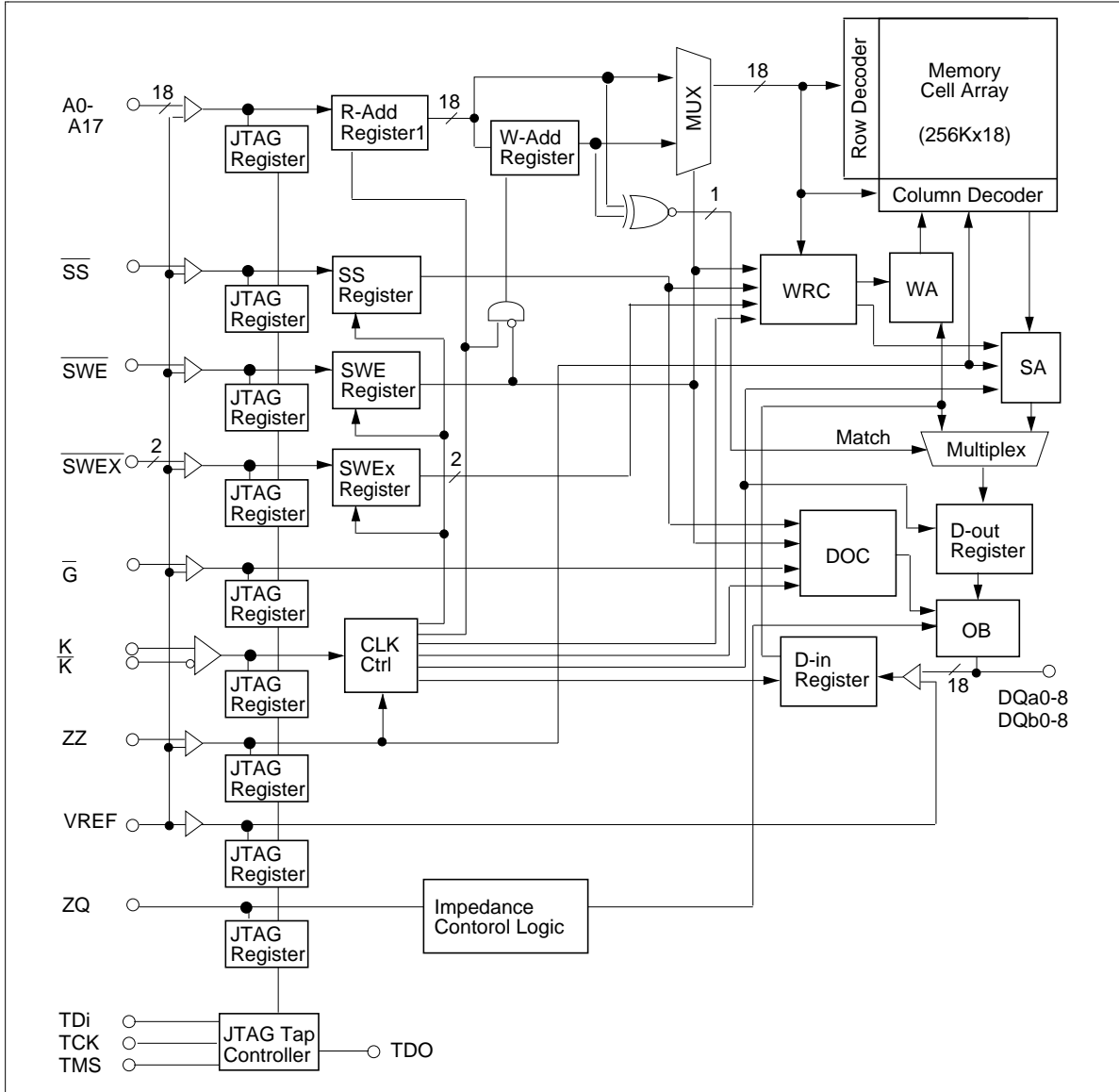
Type Number	Access Time	Cycle Time	Package
HM62G18256BP-5	2.5 ns	5.0 ns	119 Bump 1.27 mm
HM62G18256BP-4	2.2 ns	4.0 ns	14 mm x 22 mm BGA (BP-119A)

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Pin Arrangement



Block Diagram



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Pin Descriptions

Name	I/O Type	Descriptions	Note
V _{DD}	Supply	Core Power Supply	
V _{SS}	Supply	Ground	
V _{DDQ}	Supply	Output Power Supply	
V _{REF}	Supply	Input Reference : provides input reference voltage	
K	Input	Clock Input. Active high.	
K	Input	Clock Input. Active low.	
SS	Input	Synchronous Chip Select	
SWE	Input	Synchronous Write Enable	
SAn	Input	Synchronous Address Input	n=0,1,2...17
SWE _x	Input	Synchronous Byte Write Enables	x = a, b
G	Input	Asynchronous Output Enable	
ZZ	Input	Power Down Mode Select	
ZQ	Input	Output impedance control	1
DQ _{xn}	I/O	Synchronous Data Input / Output	x = a, b n=0,1,2...8
M1, M2	Input	Output Protocol Mode Select	
TMS	Input	Boundary Scan Test Mode Select	
TCK	Input	Boundary Scan Test Clock	
TDI	Input	Boundary Scan Test Data Input	
TDO	Output	Boundary Scan Test Data Output	
NC	—	No Connection	

M1	M2	Protocol
V _{SS}	V _{DD}	Synchronous register to register operation 2

- Notes:
1. ZQ is to be connected to V_{SS} via a resistance R_Q where $150\Omega \leq R_Q \leq 350\Omega$, if ZQ=V_{DDQ} or open, output buffer impedance will be maximum. A case of minimum impedance, it needs to connect over 120Ω between ZQ and V_{SS}.
 2. There is 1 protocol with mode pin. Mode control pins(M1 , M2) are to be tied either VDD or V_{SS}. The state of the Mode control inputs must be set before power-up and must not change during device operation. Mode control inputs are not standard inputs and may not meet VIH or VIL specification.

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Truth Table

ZZ	SS	G	SWE	SWEa	SWEb	K	K	Operation	DQ(n)	DQ(n+1)
H	X	X	X	X	X	X	X	sleep mode	High-Z	High-Z
L	H	X	X	X	X	L-H	H-L	Dead (not selected)	X	High-Z
L	X	H	X	X	X	X	X	Dead (Dummy read)	High-Z	High-Z
L	L	L	H	X	X	L-H	H-L	Read	X	Dout(a,b)0-8
L	L	X	L	L	L	L-H	H-L	Write a, b byte	High-Z	Din(a,b)0-8
L	L	X	L	L	H	L-H	H-L	Write a byte	High-Z	Din(a)0-8
L	L	X	L	H	L	L-H	H-L	Write b byte	High-Z	Din(b)0-8

- Notes:
1. X means don't care for synchronous inputs, and H or L for asynchronous inputs.
 2. SWE, SS, SWEa to SWEb, SA are sampled at the rising edge of K clock.
 3. Although differential clock operation is implied, this SRAM will operate properly with one clock phase (either K or \bar{K}) tied to Vref. Under such single-ended clock operation, all parameters specification within this document will be met.

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Absolute Maximum Ratings

Parameter	Symbol	Rating	Unit	Note
Input Voltage on any pin	V_{IN}	-0.5 to $V_{DDQ}+0.5$	V	1, 4
Core Supply voltage	V_{DD}	-0.5 to 3.9	V	1
Output Supply Voltage	V_{DDQ}	-0.5 to 2.2	V	1, 4
Operating Temperature	T_{OPR}	0 to 70	°C	
Storage Temperature	T_{STG}	-55 to 125	°C	
Output Short-Circuit Current	I_{OUT}	25	mA	
Latch up Current	I_{LI}	200	mA	
Package junction to case thermal resistance	θ_{JC}	2	°C/W	5,7
Package junction to ball thermal resistance	θ_{JB}	5	°C/W	6,7

- Notes:
1. All voltage are referenced to V_{SS} .
 2. Permanent device damage may occur if Absolute Maximum Ratings are exceeded. Functional operation should be restricted the Operation Conditions. Exposure to higher than recommended voltages for extended periods of time could affect device reliability.
 3. These CMOS memory circuits have been designed to meet the DC and AC specifications shown in the tables after thermal equilibrium has been established.
 4. The following supply voltage application sequence is recommended: V_{SS} , V_{DD} , V_{DDQ} , V_{ref} then V_{in} . Remember, according to the Absolute Maximum Ratings table, V_{DDQ} is not to exceed 3.9V, whatever the instantaneous value of V_{DDQ} .
 5. θ_{JC} is measured at the center of mold surface in fluorocarbon.(See Fig1.)
 6. θ_{JB} is measured on the center ball pad after removing the ball in fluorocarbon. (See Fig1.)
 7. These thermal resistance value have error of +/- 5°C/W.

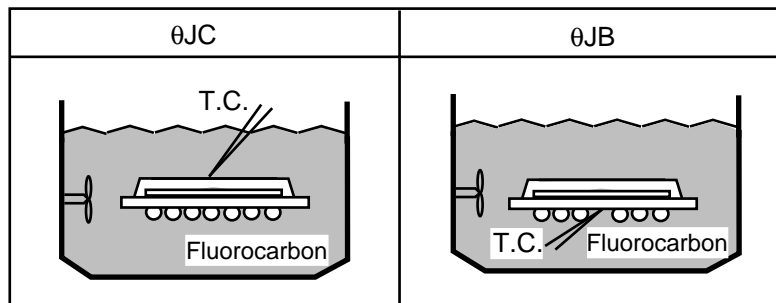


Fig.1 Definition of measurement

Recommended DC Operating Conditions ($T_a = 0$ to 70°C [T_j max = 110°C])

Parameter	Symbol	Min	Typ	Max	Unit	Notes
Power Supply voltage -- Core	V_{DD}	3.135	3.30	3.63	V	
Power Supply voltage -- I/O	V_{DDQ}	1.4	1.5	1.6	V	
Input Reference Voltage -- I/O	V_{REF}	0.65	0.75	0.90	V	1
Input High Voltage	V_{IH}	$V_{REF} + 0.1$	—	$V_{DDQ} + 0.3$	V	
Input Low Voltage	V_{IL}	-0.5	—	$V_{REF} - 0.1$	V	
Clock Differential Voltage	V_{DIF}	0.1	—	$V_{DDQ} + 0.3$	V	2, 3
Clock Common Mode Voltage	V_{CM}	0.55	—	0.90	V	3

- Notes :
1. Peak to Peak AC component superimposed on V_{ref} may not exceed 5% of V_{ref} .
 2. Minimum differential input voltage required for differential input clock operation.
 3. See Figure 1.

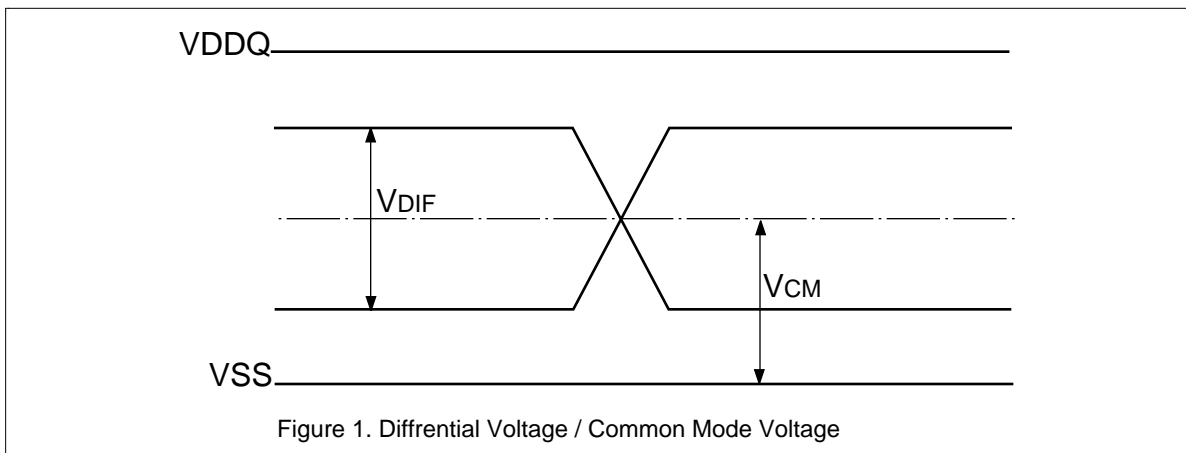


Figure 1. Differential Voltage / Common Mode Voltage

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DC Characteristics ($T_a = 0$ to 70°C , $[T_{j\text{max}}=110^\circ\text{C}]$, $V_{\text{DD}} = 3.3\text{V}+10\%$, -5%)

Parameter	Symbol	Min	Max	Unit	Note	
Input Leakage Current	I_{LI}	—	2	μA	1	
Output Leakage Current	I_{LO}	—	5	μA	2	
Standby Current	I_{SBZZ}	—	100	mA	3	
VDD Operating Current, excluding output drivers.	4ns cycle	I_{DD4}	—	500	mA	4
	5ns cycle	I_{DD5}	—	500	mA	4
Quiescent Active Power Supply Current.	I_{DD2}	—	180	mA	5	

Parameter	Symbol	Min	Typ	Max	Unit	Note
Output Low Voltage	V_{OL}	V_{SS}	—	$V_{\text{SS}}+0.4$	V	6
Output High Voltage	V_{OH}	$V_{\text{DDQ}}-0.4$	—	V_{DDQ}	V	6
ZQ pin Connect Resistance	RQ	150	250	350	Ω	
Output "Low" Current	I_{OL}	$(V_{\text{DDQ}}/2)/[(\text{RQ}/5)-15\%]$		$(V_{\text{DDQ}}/2)/[(\text{RQ}/5)+15\%]$	mA	7,9
Output "High" Current	I_{OH}	$(V_{\text{DDQ}}/2)/[(\text{RQ}/5)+15\%]$		$(V_{\text{DDQ}}/2)/[(\text{RQ}/5)-15\%]$	mA	8,9

- Note:
- $0 \leq V_{\text{in}} \leq V_{\text{DDQ}}$ for all input pins(except V_{REF} , ZQ, M1, M2 pin)
 - $0 \leq V_{\text{OUT}} \leq V_{\text{DDQ}}$, DQ in High-Z
 - All inputs (except clock) are held at either V_{IH} or V_{IL} , ZZ is held at V_{IH} , $I_{\text{out}}=0$ mA
 - $I_{\text{out}} = 0$ mA, read 50% / write 50%, $V_{\text{DD}} = V_{\text{DD}} \text{ max}$, Frequency = min.cycle
 - $I_{\text{out}} = 0$ mA, read 50% / write 50%, $V_{\text{DD}} = V_{\text{DD}} \text{ max}$, Frequency = 3 Mhz
 - Minimum impedance push pull output buffer mode, $I_{\text{OH}}=-6\text{mA}$, $I_{\text{OL}}=6\text{mA}$
 - Measured at $V_{\text{OL}}=1/2 V_{\text{DDQ}}$
 - Measured at $V_{\text{OH}}=1/2 V_{\text{DDQ}}$
 - Output buffer impedance can be programmed by terminating the ZQ pin to VSS through a precision resistor(RQ). The value of RQ is five times the output impedance desired. The allowable range of RQ to guarantee impedance matching with a tolerance of 15% is between 150Ω and 350Ω . If the status of ZQ pin is open, output impedance is maximum. Maximum impedance occurs with ZQ connected to VDDQ. The impedance update of the output driver occurs when the SRAM is in High-Z. Write and Deselect operations will synchronously switch the SRAM into and out of High-Z, therefore triggering an update. The user may choose to invoke asynchronous G updates by providing a G setup and hold about the K clock to guarantee the proper update. At power up, the output impedance default to minimum impedance. It will take 1024 cycles for the impedance to be completely updated if the programmed impedance is much higher than minimum impedance.

AC Characteristics ($0^{\circ}\text{C} \leq T_a \leq 70^{\circ}\text{C}$ [Tj max = 110°C], $V_{DD} = 3.3\text{V} + 10\%, -5\%$)

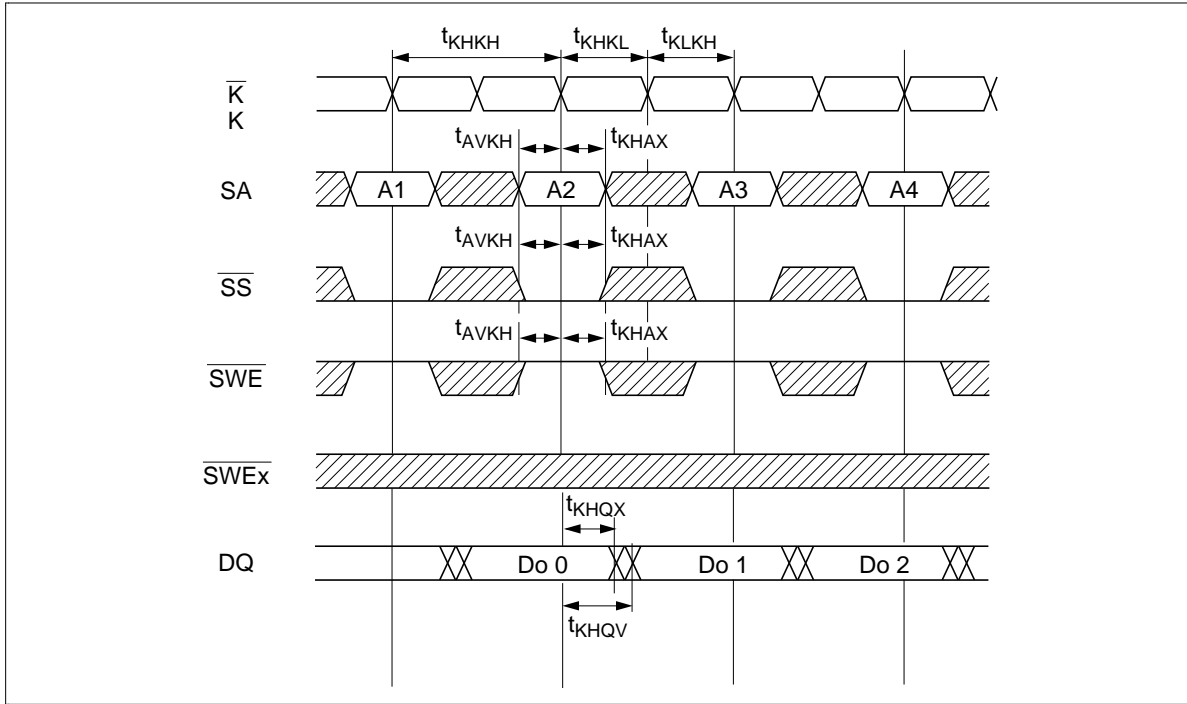
Single Differential Clock Register-Register Mode ($M1 = V_{SS}, M2 = V_{DD}$)

Parameter	Symbol	- 4		- 5		Unit	Notes
		Min	Max	Min	Max		
CK Clock Cycle time	t_{KHKH}	4.0	—	5.0	—	ns	
CK Clock High Width	t_{KHKL}	1.5	—	1.5	—	ns	
CK Clock Low Width	t_{KLKH}	1.5	—	1.5	—	ns	
Address Setup Time	t_{AVKH}	0.5	—	0.5	—	ns	
Data Setup Time	t_{DVKH}	0.5	—	0.5	—	ns	
Address Hold Time	t_{KHAX}	—	0.75 ¹⁾	—	1.0	ns	
Data Hold Time	t_{KHDX}	—	0.75 ¹⁾	—	1.0	ns	
Clock High to output valid	t_{KHQV}	—	2.2	—	2.5	ns	2
Clock High to output hold	t_{KHQX}	0.5	—	0.5	—	ns	2
Clock High to output valid(/SS ctrl.)	t_{KHQX2}	—	2.2	—	2.5	ns	2,5
Clock High to output High-Z	t_{KHQZ}	—	2.5	—	3.0	ns	2,3
Output Enable low to output Low-Z	t_{GLQX}	0.5	—	0.5	—	ns	2,5
Output Enable low to output valid	t_{GLQV}	—	2.5	—	2.5	ns	2,3
Output Enable low to output High-Z	t_{GHQZ}	—	2.5	—	2.5	ns	2,3
Sleep mode recovery time	t_{ZZR}	10.0	—	10.0	—	ns	
Sleep mode enable time	t_{ZZE}	—	10.0	—	10.0	ns	2,3

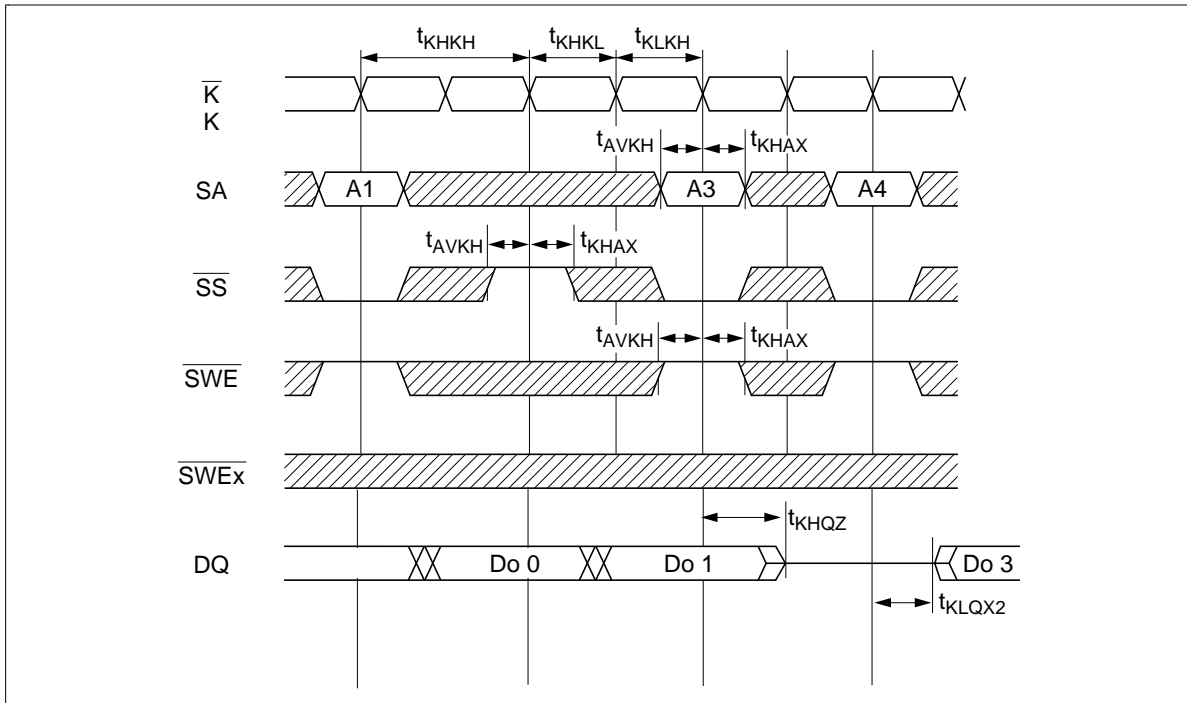
- Notes:
1. Guaranteed by design.
 2. See AC Test Loading figure.
 3. Transitions are measured at start point of output high impedance from output low impedance.
 4. Output Driver Impedance update specifications for G induced updates. Write and Deselected cycles will also induce Output Driver updates during High-Z.
 5. Transitions are measured $\pm 50\text{mV}$ from steady state voltage.

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Read Cycle 1

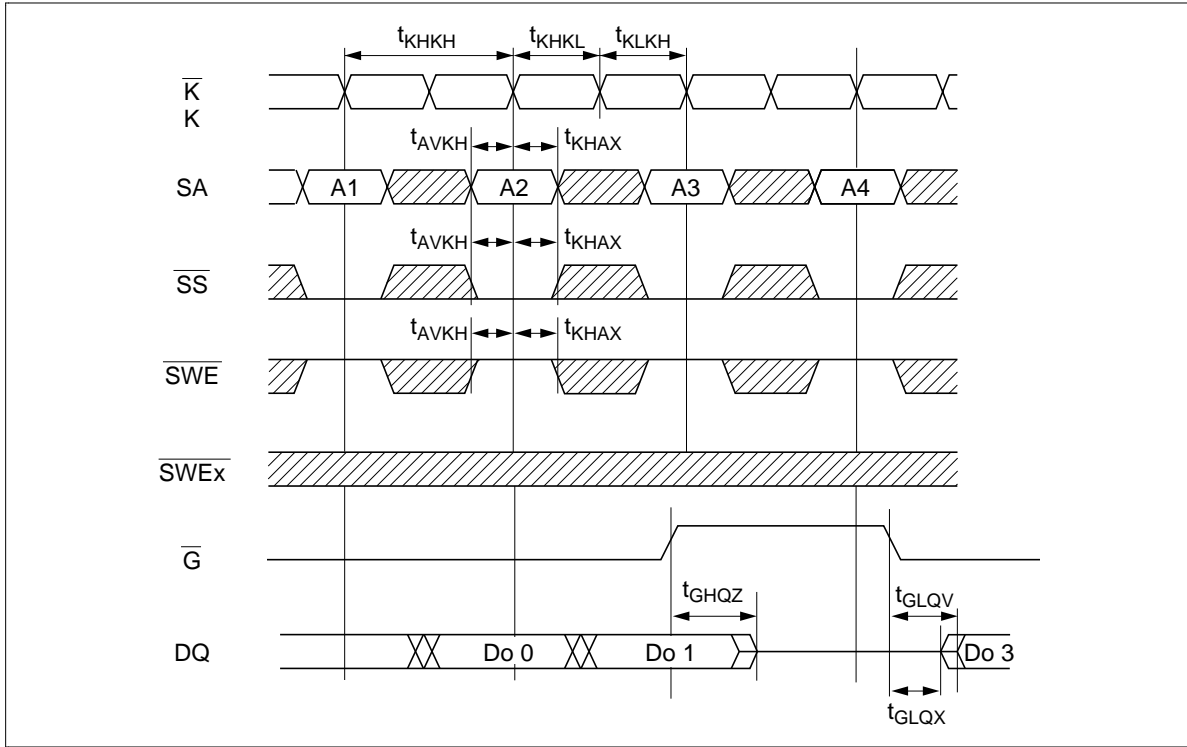


Read Cycle 2 (\overline{SS} Controlled)

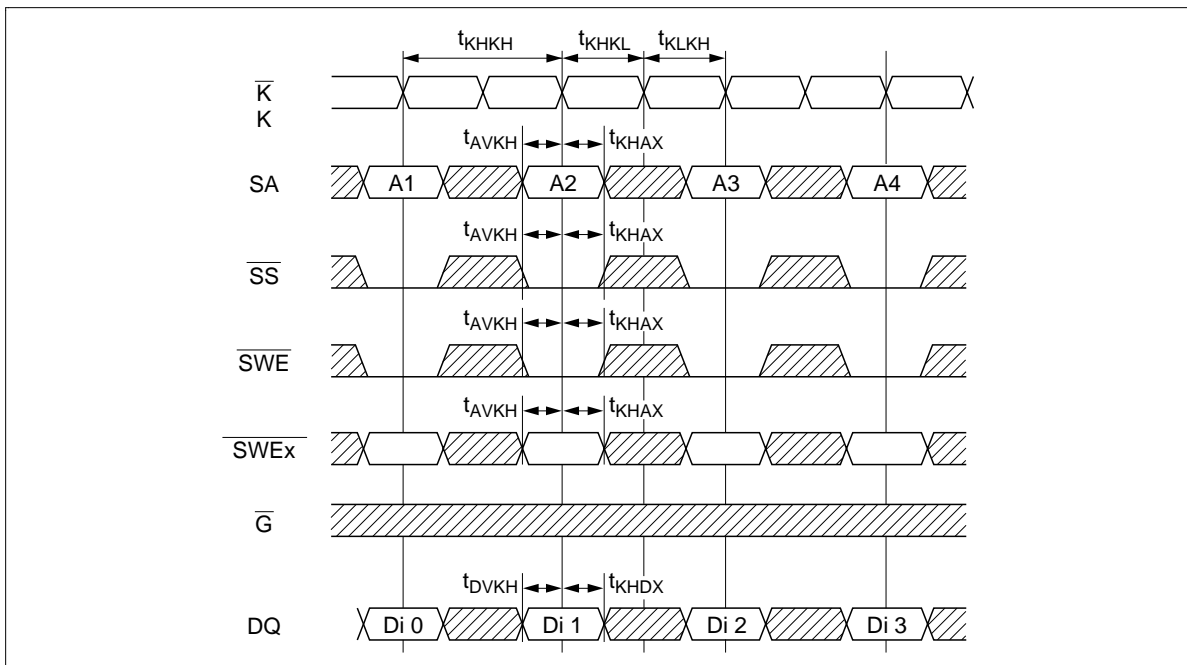


Notes: G, ZZ = VIL, x = a, b

Read Cycle 3 (/G Controlled)



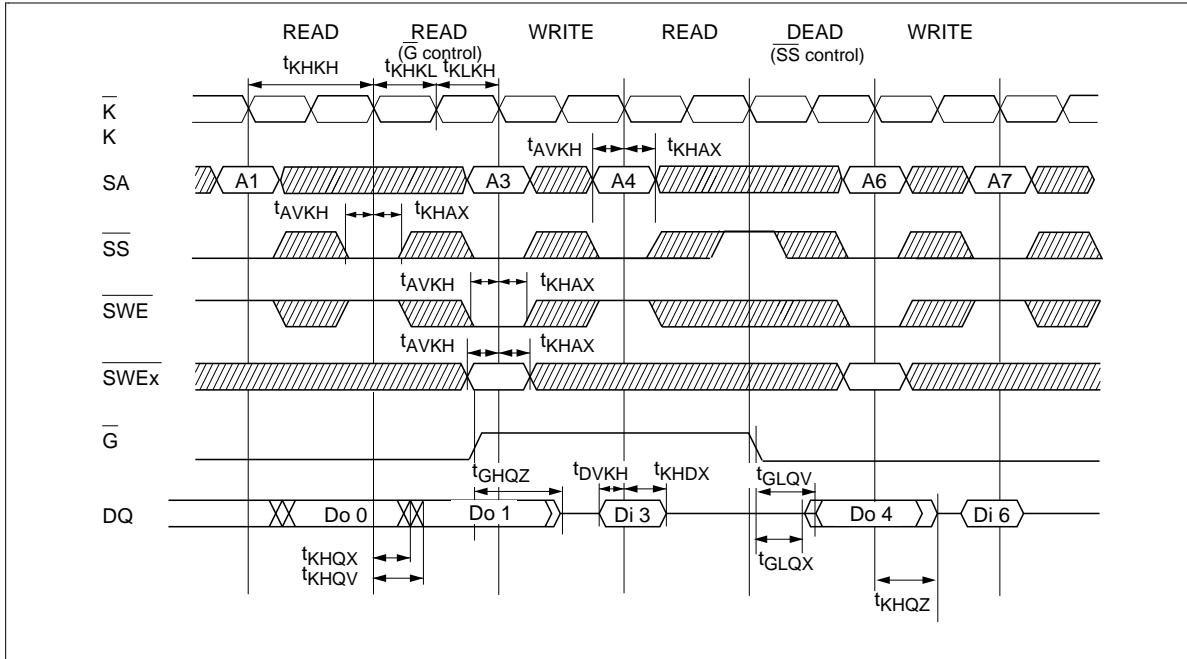
Write Cycle



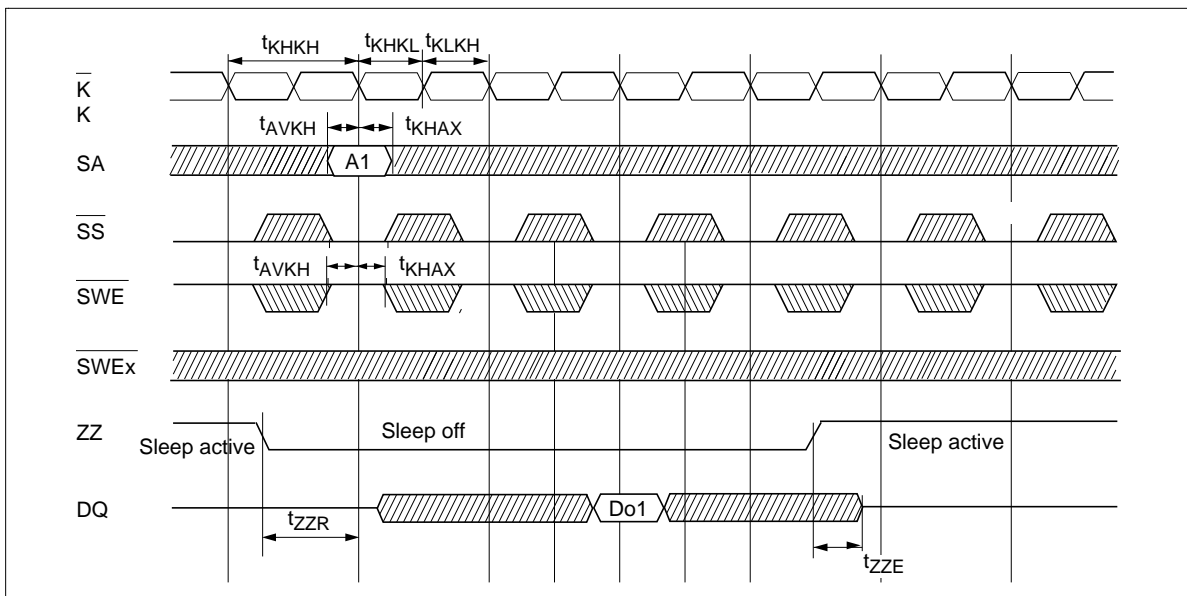
Notes: ZZ=VIL,x=a,b

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Read-Write Cycle



ZZ Control



Notes: G,ZZ= \overline{VIL} ,x=a,b

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Input Capacitance ($T_a = 25^\circ\text{C}$, $f = 1\text{ MHz}$)

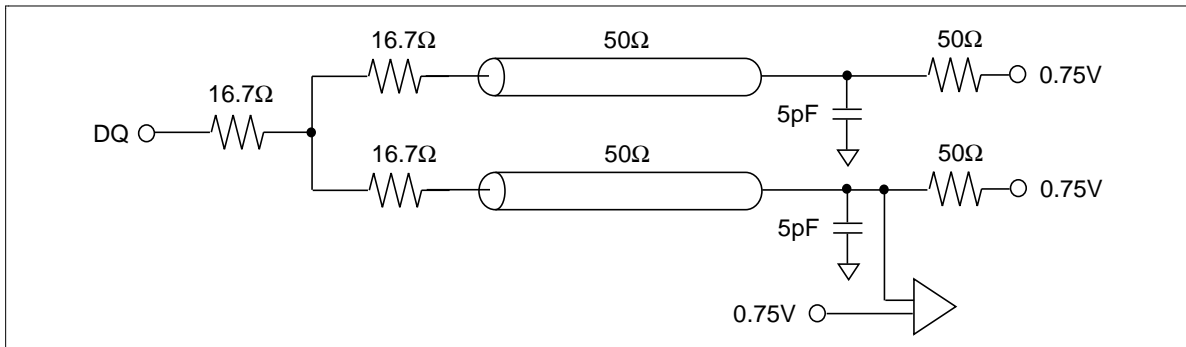
Parameter	Symbol	Min	Max	Unit	Pin Name
Input Capacitance	C_{IN}	—	4	pF	SAn, SS, SWE, SWEx
Clock Input Capacitance	C_{CLK}	—	7	pF	K, K, G
I/O Capacitance	C_{IO}	—	5	pF	DQxn

Note : This parameter is sampled and not 100% tested.

AC Test Conditions

Parameter	Symbol	Conditions	Unit	Note
Input and output timing reference levels	V_{REF}	0.75	V	
Input signal amplitude	V_{IL} , V_{IH}	0.25 to 1.25	V	
Input rise / fall time	t_r , t_f	0.5 (10% to 90%)	ns	
Clock input timing reference level		Differential Cross Point		
V_{DIF} to Clock		0.75	V	
V_{CM} to Clock		0.75	V	
Output Loading conditions		See Figures		

Note : Measurement condition is the minimum impedance push pull output buffer mode, $I_{OH}=-6\text{mA}$, $I_{OL}=6\text{mA}$



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Boundary Scan Test Access Port Operations

overview

In order to perform the interconnect testing of the modules that include this SRAM, the serial boundary scan test access port (TAP) is designed to operate in a manner consistent with IEEE Standard 1149.1 - 1990. But does not implement all of the functions required for 1149.1 compliance. The HM62G series contains a TAP controller. Instruction register, Boundary scan register, Bypass register and ID register.

Test Access Port Pins

Symbol I/O	Name
TCK	Test Clock
TMS	Test Mode Select
TDI	Test Data In
TDO	Test Data Out

Notes: This Device does not have a TRST (TAP Reset) pin. TRST is optional in IEEE 1149.1.
To disable the TAP, TCK must be connected to Vss. TDO should be left unconnected.
To test Boundary scan, ZZ pin need to be kept below Vref -0.4V.

TAP DC Operating Characteristics (Ta = 0°C to 70°C [Tj max = 110°C])

Parameter	Symbol	Min	Max	Note
Boundary scan Input High voltage	V _{IH}	2.0 V	V _{DD} + 0.3 V	
Boundary scan Input Low voltage	V _{IL}	-0.5 V	0.8 V	
Boundary scan Input Leakage Current	I _{LI}	-2μA	+2μA	1
Boundary scan Output Low voltage	V _{OL}		0.4 V	2
Boundary scan Output High voltage	V _{OH}	2.4 V		3

Notes: 1. $0 \leq V_{in} \leq V_{DD}$ for all logic input pin
2. I_{OL} = -8 mA
3. I_{OH} = 8 mA

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TAP AC Operating Characteristics (Ta = 0°C to 70°C [Tj max = 110 °C])

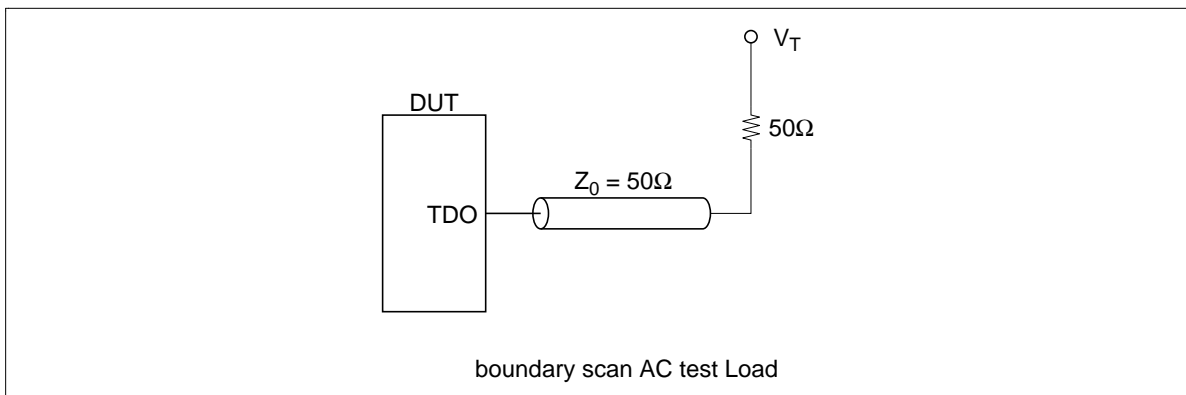
Parameter	Symbol	Min	Max	Unit	Note
Test Clock Cycle Time	t _{THTH}	67	—	ns	
Test Clock High Pulse Width	t _{THTL}	30	—	ns	
Test Clock Low Pulse Width	t _{TLTH}	30	—	ns	
Test Mode Select Setup	t _{MVTH}	10	—	ns	
Test Mode Select Hold	t _{THMX}	10	—	ns	
Capture Setup	t _{CS}	10	—	ns	1
Capture Hold	t _{CH}	10	—	ns	1
TDI Valid to TCK High	t _{DVTH}	10	—	ns	
TCK High to TDI Don't Care	t _{THDX}	10	—	ns	
TCK Low to TDO Unknown	t _{TLQX}	0	—	ns	
TCK Low to TDO Valid	t _{TLQV}	—	20	ns	

Note: 1. t_{CS} + t_{CH} defines the minimum pause in RAM I/O pad transitions to assure pad data capture.

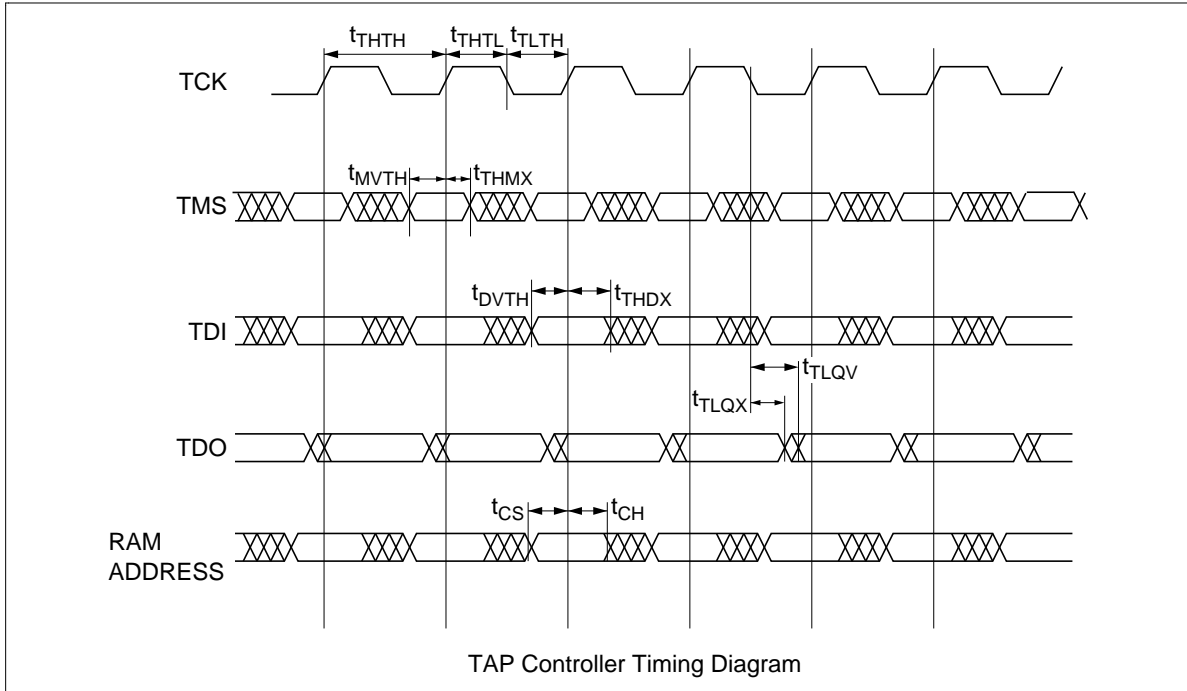
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TAP AC Test Conditions

- Temperature $0^{\circ}\text{C} \leq T_a \leq 70^{\circ}\text{C}$ [T_j max = 110°C]
- Input timing measurement reference Level 1.5 V
- Input pulse levels 0 to 3.0 V
- Input Rise/Fall Time 2.0 ns typical (10% to 90%)
- Output timing measurement reference Level 1.5 V
- Test load termination supply voltage (V_T) 1.5 V
- Output Load See figures



TAP Controller Timing Diagram



Test Access Port Registers

Register Name	Length	Symbol	Note
Instruction Register	3 bits	IR [0;2]	
Bypass Register	1 bits	BP	
ID Register	32 bits	ID [0;31]	
Boundary Scan Register	51 bits	BS [1;51]	HM62G18256 series

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TAP Controller Instruction Set

IR2	IR1	IR0	Instruction	Operation
0	0	0	SAMPLE-Z	Tristate all data drivers and capture the pad value
0	0	1	IDCODE	
0	1	0	SAMPLE-Z	Tristate all data drivers and capture the pad value
0	1	1	BYPASS	
1	0	0	SAMPLE	
1	0	1	BYPASS	
1	1	0	BYPASS	
1	1	1	BYPASS	

Note: This Device does not perform EXTEST, INTEST or the preload portion of the PRELOAD command in IEEE 1149.1.

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Boundary Scan Order

Bit #	Bump ID	Signal Name	Bit #	Bump ID	Signal Name
1	5R	M2	36	3G	SWEb
2	6T	SA15	37	4D	ZQ
3	4P	SA14	38	4E	SS
4	6R	SA10	39	4G	NC
5	5T	SA12	40	4H	NC
6	7T	ZZ	41	4M	SWE
7	7P	DQa0	42	2K	DQb8
8	6N	DQa1	43	1L	DQb7
9	6L	DQa2	44	2M	DQb6
10	7K	DQa3	45	1N	DQb5
11	5L	SWEa	46	2P	DQb4
12	4L	K	47	3T	SA11
13	4K	K	48	2R	SA9
14	4F	G	49	4N	SA16
15	6H	DQa8	50	2T	SA17
16	7G	DQa7	51	3R	M1
17	6F	DQa6			
18	7E	DQa5			
19	6D	DQa4			
20	6A	SA2			
21	6C	SA1			
22	5C	SA5			
23	5A	SA4			
24	6B	NC			
25	5B	SA8			
26	3B	SA7			
27	2B	NC			
28	3A	SA6			
29	3C	SA3			
30	2C	SA13			
31	2A	SA0			
32	1D	DQb0			
33	2E	DQb1			
34	2G	DQb2			
35	1H	DQb3			

Notes: 1. Bit#1 is the first scan bit to exit the chip.

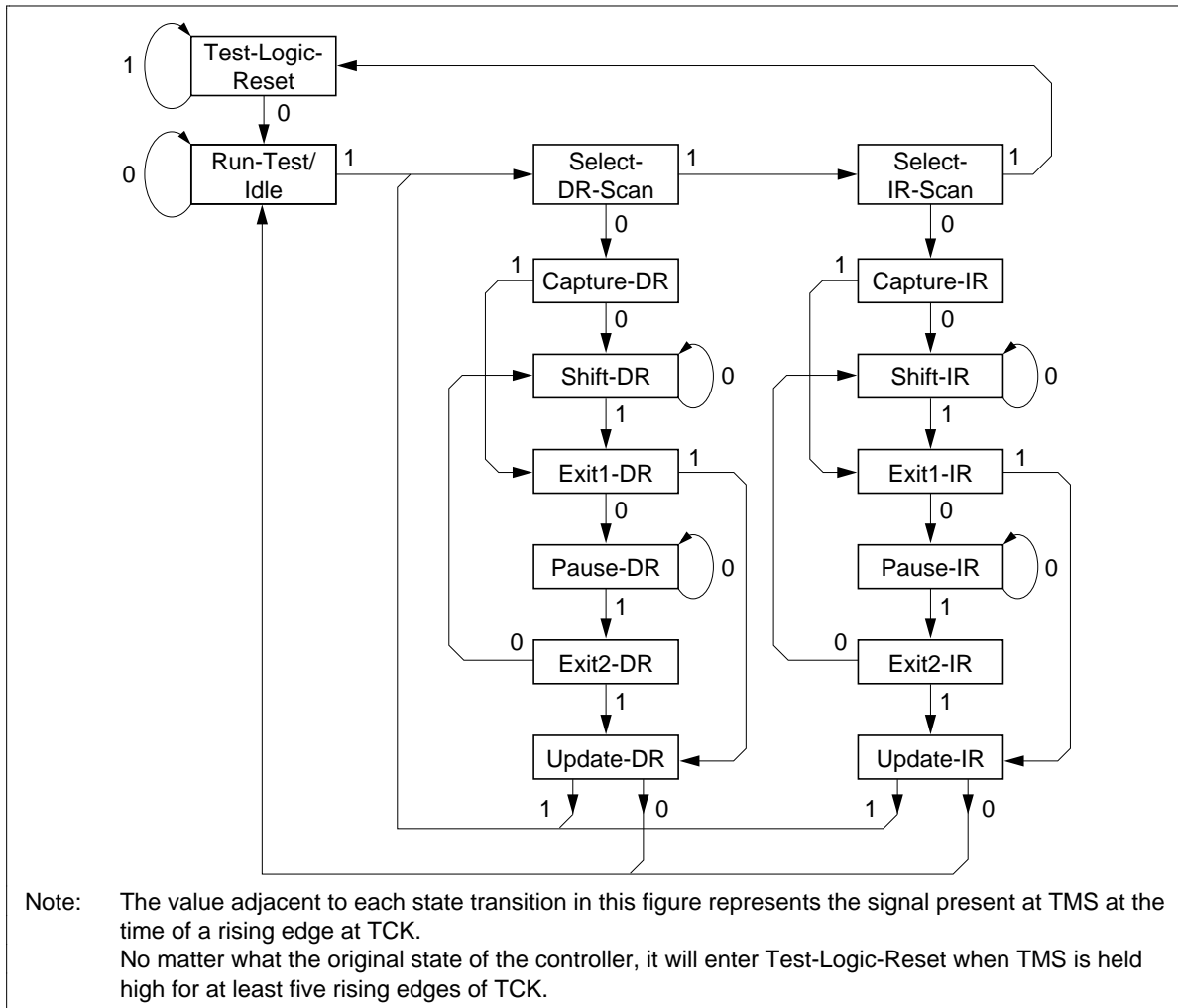
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2. The NC pads listed in this table are indeed no connects, but are represented in the boundary scan register by a "Place Holder". Place holder registers are internally connected to VSS.
3. In Boundary scan mode, differential input K and K are referenced to each other and must be at opposite logic levels for reliable operation.
4. ZZ must remain at V_{IL} during boundary scan.
5. In boundary scan mode, ZQ must be driven to VDDQ or VSS supply rail to ensure consistent results.
6. M1 and M2 must be driven to VDD or VSS supply rail to ensure consistent results.

ID 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	
Value	x	x	x	1	0	0	1	1	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1
	Vendor Revision No.			Depth			Width			Use in the future			Vendor ID No.					Fix															

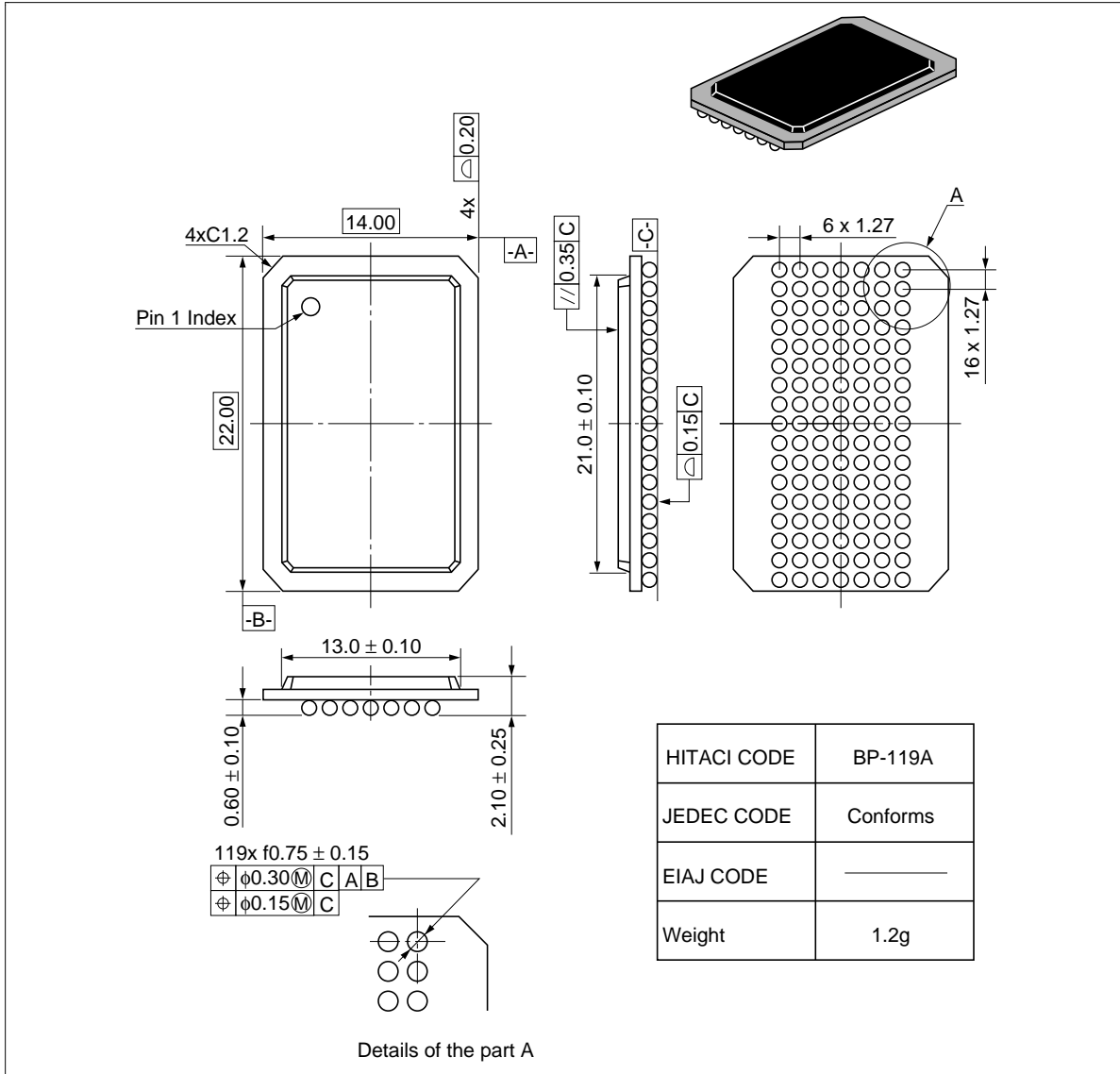
TAP Controller State Diagram



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Package Outline

(BP-119A) (Unit : mm)



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Semiconductor & IC Div.
Nippon Bldg., 2-6-2, Ohte-machi, Chiyoda-ku, Tokyo 100-0004, Japan
Tel: Tokyo (03) 3270-2111 Fax: (03) 3270-5109

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For further information write to:

Hitachi Semiconductor
(America) Inc.
179 East Tasman Drive,
San Jose, CA 95134
Tel: <1> (408) 433-1990
Fax: <1>(408) 433-0223

Hitachi Europe GmbH
Electronic components Group
Dornacher Straße 3
D-85622 Feldkirchen, Munich
Germany
Tel: <49> (89) 9 9180-0
Fax: <49> (89) 9 29 30 00

Hitachi Europe Ltd.
Electronic Components Group.
Whitebrook Park
Lower Cookham Road
Maidenhead
Berkshire SL6 8YA, United Kingdom
Tel: <44> (1628) 585000
Fax: <44> (1628) 778322

Hitachi Asia Pte. Ltd.
16 Collyer Quay #20-00
Hitachi Tower
Singapore 049318
Tel: 535-2100
Fax: 535-1533

Hitachi Asia Ltd.
Taipei Branch Office
3F, Hung Kuo Building, No.167,
Tun-Hwa North Road, Taipei (105)
Tel: <886> (2) 2718-3666
Fax: <886> (2) 2718-8180

Hitachi Asia (Hong Kong) Ltd.
Group III (Electronic Components)
7/F., North Tower, World Finance Centre,
Harbour City, Canton Road, Tsim Sha Tsui,
Kowloon, Hong Kong
Tel: <852> (2) 735 9218
Fax: <852> (2) 730 0281
Telex: 40815 HITEC HX

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