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FEDS82V16520A-01
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MS82V16520A

262,144-Word × 32-Bit × 2-Bank SGRAM

GENERAL DESCRIPTION

The MS82V16520A is a 16-Mbit system clock synchronous dynamic random access memory.

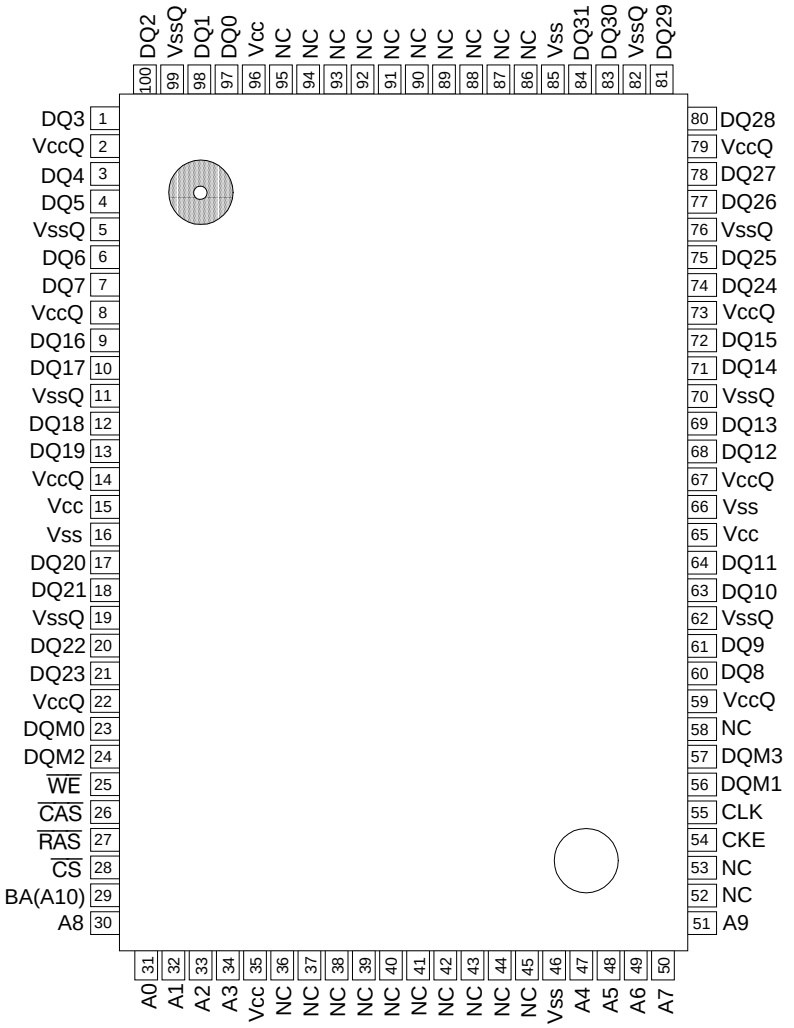
FEATURES

- 262,144 words × 32 bits × 2 banks memory (1,024 rows × 256 columns × 32 bits × 2 banks)
- Single 3.3 V ±0.3 V power supply
- LVTTL compatible inputs and outputs
- Programmable burst length (1, 2, 4, 8 and full page)
- Programmable $\overline{\text{CAS}}$ latency (2, 3)
- Power Down operation and Clock Suspend operation
- 2,048 refresh cycles/32 ms
- Auto refresh and self refresh capability
- Package:
  100-pin plastic QFP (QFP100-P-1420-0.65-BK4) (MS82V16520A-xGA)
  x indicates speed rank.

PRODUCT FAMILY

Family	Max. Operating Frequency	Access Time	Package
MS82V16520A-7	143 MHz	6 ns	100-pin Plastic QFP
MS82V16520A-8	125 MHz	6.5 ns	

PIN CONFIGURATION (TOP VIEW)

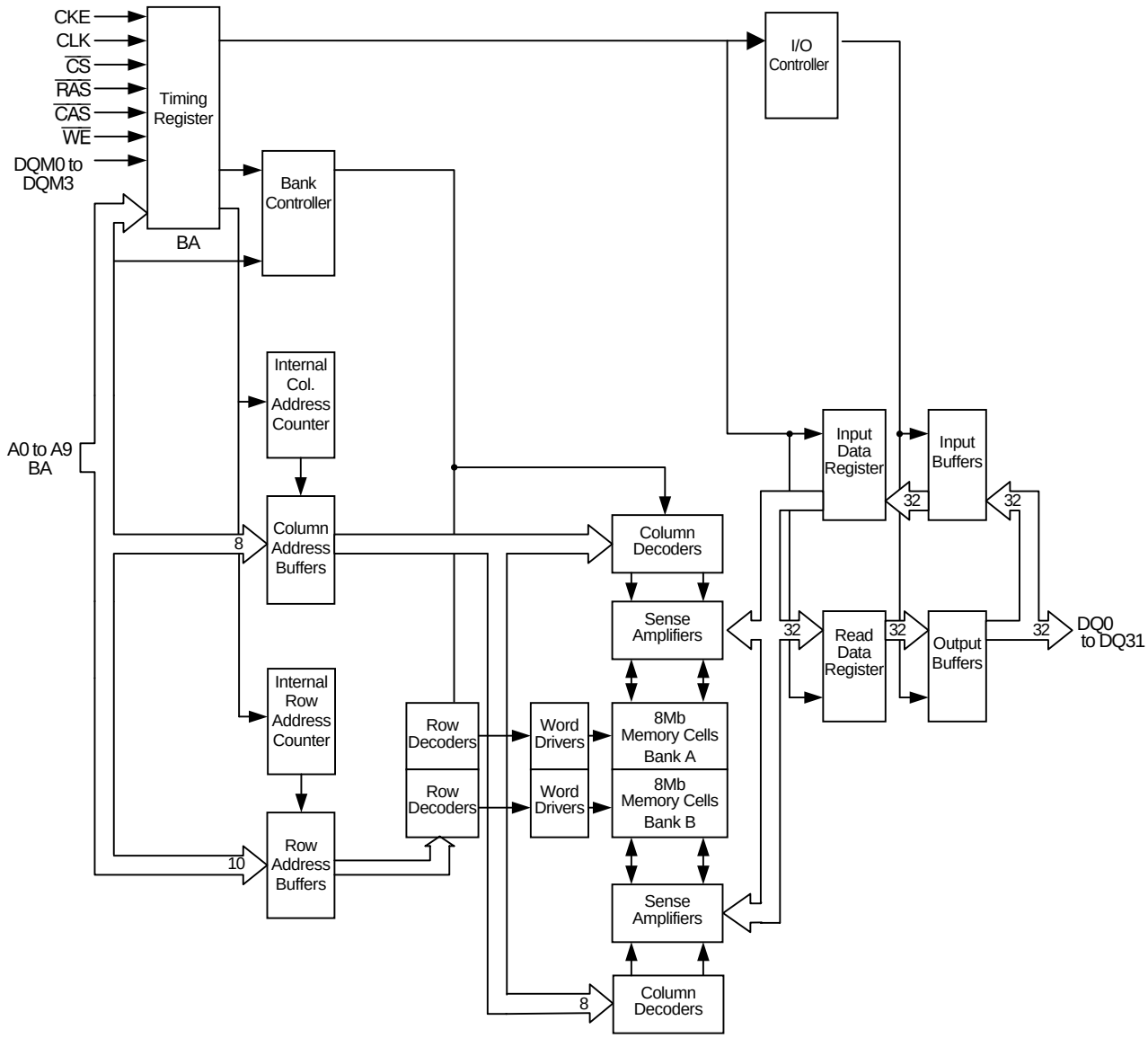


100-Pin Plastic QFP

Pin Name	Function	Pin Name	Function
A0 to A9	Row Address Inputs	$\overline{WE}$	Write Enable
A0 to A7	Column Address Inputs	DQM0 to DQM3	DQ Mask Enable
BA (A10)	Bank Address	DQ0 to DQ31	Data Inputs/outputs
CLK	System Clock Input	V_{CC}	Supply Voltage
CKE	Clock Enable	V_{SS}	Ground
$\overline{CS}$	Chip Select	$V_{CC}Q$	Supply Voltage for DQ
$\overline{RAS}$	Row Address Strobe	$V_{SS}Q$	Ground for DQ
$\overline{CAS}$	Column Address Strobe	NC	No Connection

Note: The same power supply voltage level must be provided to every V_{CC} pin and $V_{CC}Q$ pin.
The same GND voltage level must be provided to every V_{SS} pin and $V_{SS}Q$ pin.

BLOCK DIAGRAM



PIN DESCRIPTION

CLK	Fetches all inputs at the "H" edge.
$\overline{CS}$	Disables or enables device operation by asserting or deactivating all inputs except CLK, CKE, DQM0, DQM1, DQM2 and DQM3.
CKE	Masks system clock to deactivate the subsequent CLK operation. If CKE is deactivated, system clock will be masked so that the subsequent CLK operation is deactivated. CKE should be asserted at least one cycle prior to a new command.
Address	Row & column multiplexed. Row address: RA0 to RA9, Column address: CA0 to CA7
BA	Selects bank to be activated during row address latch time and selects bank for precharge and read/write during column address latch time. BA = “L”: Bank A BA = “H”: Bank B
$\overline{RAS}$ $\overline{CAS}$ $\overline{WE}$	Functionality depends on the combination. For details, see the function truth table.
DQM0 to DQM3	Masks the read data of two clocks later when DQM0 to DQM3 are set "H" at the "H" edge of the clock signal. Masks the write data of the same clock when DQM0 to DQM3 are set "H" at the "H" edge of the clock signal. DQM0 controls DQ0 to DQ7, DQM1 controls DQ8 to DQ15, DQM2 controls DQ16 to DQ23, and DQM3 controls DQ24 to DQ31.
DQ0 to DQ31	Data inputs/outputs are multiplexed on the same pin.

*Notes: 1. When $\overline{CS}$ is set "High" at a clock transition from "Low" to "High", all inputs except CLK, CKE, DQM0, DQM1, DQM2, and DQM3 are invalid.

2. When issuing an active, read or write command, the bank is selected by BA.

BA	Active, read or write
0	Bank A
1	Bank B

3. The auto precharge function is enabled or disabled by the A9 input when the read or write command is issued.

A9	BA	Operation
0	0	After the end of burst, bank A holds the active status.
1	0	After the end of burst, bank A is prechaged automatically.
0	1	After the end of burst, bank B holds the active status.
1	1	After the end of burst, bank B is prechaged automatically.

4. When issuing a precharge command, the bank to be precharged is selected by the A9 and BA inputs.

A9	BA	Operation
0	0	Bank A is precharged.
0	1	Bank B is precharged.
1	×	Both banks are precharged.

COMMAND OPERATION

Mode Register Set Command (CS, RAS, CAS, WE = "Low")

The MS82V16520A has the mode register that defines the operation mode "$\overline{\text{CAS}}$ Latency, Burst Length, Burst Sequence". The Mode Register Set command should be executed just after the MS82V16520A is powered on. Before entering this command, all banks must be precharged. Next command can be issued after t_{RSC}.

Auto Refresh Command (CS, RAS, CAS = "Low", WE, CKE = "High")

The Auto Refresh command performs refresh automatically by the address counter. The refresh operation must be performed 2,048 times within 32 ms and the next command can be issued after t_{RC} from last Auto Refresh command. Before entering this command, all banks must be precharged.

Self Refresh Entry/Exit Command (CS, RAS, CAS, CKE = "Low", WE = "High")

The self refresh operation continues after the Self Refresh Entry command is entered, with CKE level left "low". This operation terminates by making CKE level "high". The self refresh operation is performed automatically by the internal address counter on the MS82V16520A chip.
In self refresh mode, no external refresh control is required. Before entering self refresh mode, all banks must be precharged. Next command can be issued after t_{RC}.

Single Bank Precharge Command (CS, RAS, WE, A9 = "Low", CAS = "High")

The Single Bank Precharge command triggers bank precharge operation. Precharge bank is selected by BA.

All Bank Precharge Command (CS, RAS, WE = "Low", CAS, A9 = "High")

The All Bank Precharge command triggers precharge of both Bank A and Bank B.

Bank Active Command (CS, RAS = "Low", CAS, WE = "High")

The Bank Active command activates the bank selected by BA. The Bank Active command corresponds to conventional DRAM's $\overline{\text{RAS}}$ falling operation. Row addresses "A0 to A9 and BA" are strobed.

Write Command (CS, CAS, WE, A9 = "Low", RAS = "High")

The Write command is required to begin burst write operation. Then burst access initial bit column address is strobed.

Write with Auto Precharge Command (CS, CAS, WE = "Low", RAS, A9 = "High")

The Write with Auto Precharge command is required to begin burst write operation with automatic precharge after the burst write. Any command that interrupts this operation cannot be issued.

Read Command (CS, CAS, A9 = "Low", RAS, WE = "High")

The Read command is required to begin burst read operation. Then burst access initial bit column address is strobed.

Read with Auto Precharge Command (CS, CAS = "Low", RAS, WE, A9 = "High")

The Read with Auto Precharge command is required to begin burst read operation with automatic precharge after the burst read. Any command that interrupts this operation cannot be issued.

No Operation Command (CS = "Low", RAS, CAS, WE = "High")

The No Operation command does not trigger any operation.

Device Deselect Command (CS = "High")

The Device Deselect command disables the $\overline{RAS}$, $\overline{CAS}$, $\overline{WE}$ and Address input. This command does not trigger any operation.

Data Write/Output Enable Command (DQMi = "Low")

The Data Write/Output Enable command enables DQ0 to DQ31 in read or write.
The each DQM0, 1, 2 and 3 corresponds to DQ0 to DQ7, DQ8 to DQ15, DQ16 to DQ23 and DQ24 to DQ31 respectively.

Data Mask/Output Disable Command (DQMi = "High")

The Data Mask/Output Disable command disables DQ0 to DQ31 in read or write. In read cycle output buffers are disabled after 2 clocks . In write cycle input buffers are disabled at the same clock. The each DQM0, 1, 2 and 3 corresponds to DQ0 to DQ7, DQ8 to DQ15, DQ16 to DQ23 and DQ24 to DQ31 respectively.

Burst Stop Command (CS, WE = "Low", RAS, CAS = "High")

The Burst Stop command stops burst access when the access is in full page. After the Burst Stop command is entered, the output buffer goes into high impedance state.

TRUTH TABLE

Command Truth Table

Function	$\overline{CS}$	$\overline{RAS}$	$\overline{CAS}$	$\overline{WE}$	Address		
					BA	A9	A8 to A0
Device Deselect	H	×	×	×	×	×	×
No Operation	L	H	H	H	×	×	×
Mode Register Set	L	L	L	L	OP. CODE		
Auto Refresh	L	L	L	H	×	×	×
Bank Activate	L	L	H	H	BA	RA	
Read	L	H	L	H	BA	L	CA (A7 to A0)
Read with Auto Precharge	L	H	L	H	BA	H	CA (A7 to A0)
Write	L	H	L	L	BA	L	CA (A7 to A0)
Write with Auto Precharge	L	H	L	L	BA	H	CA (A7 to A0)
Precharge Select Bank	L	L	H	L	BA	L	×
Precharge All Banks	L	L	H	L	×	H	×
Burst Stop	L	H	H	L	×	×	×

DQM Truth Table

Function	DQMi
Data Write/Output Enable	L
Data Mask/Output Disable	H

Function Truth Table (1/2)

Note 1

Current State	$\overline{CS}$	$\overline{RAS}$	$\overline{CAS}$	$\overline{WE}$	BA	Address	Action	Note
Idle	H	×	×	×	×	×	NOP	
	L	H	H	H	×	×	NOP	
	L	H	H	L	BA	×	ILLEGAL	2
	L	H	L	×	BA	CA, A9	ILLEGAL	2
	L	L	H	H	BA	RA	Row Active	
	L	L	L	L	L	Op-Code	Mode Register Write	
	L	L	H	L	BA	A9	NOP	4
	L	L	L	H	×	×	Auto Refresh/Self refresh	5
Active (ACT)	H	×	×	×	×	×	NOP	
	L	H	H	×	×	×	NOP	
	L	H	L	H	BA	CA, A9	Read	
	L	H	L	L	BA	CA, A9	Write	
	L	L	H	H	BA	RA	ILLEGAL	2
	L	L	H	L	BA	A9	Precharge	
	L	L	L	×	×	×	ILLEGAL	
Read (RD)	H	×	×	×	×	×	NOP (Continue Row Active after Burst ends)	
	L	H	H	H	×	×	NOP (Continue Row Active after Burst ends)	
	L	H	H	L	×	×	1,2,4,8 Burst Length : ILLEGAL Full Page Burst : Burst Stop → Row Active	
	L	H	L	H	BA	CA, A9	Term Burst, new Read	3
	L	H	L	L	BA	CA, A9	Term Burst, start Write	3
	L	L	H	H	BA	RA	ILLEGAL	2
	L	L	H	L	BA	A9	Term Burst, execute Precharge	
	L	L	L	×	×	×	ILLEGAL	
Write (WT)	H	×	×	×	×	×	NOP (Continue Row Active after Burst ends)	
	L	H	H	H	×	×	NOP (Continue Row Active after Burst ends)	
	L	H	H	L	×	×	1,2,4,8 Burst Length : ILLEGAL Full Page Burst : Burst Stop → Row Active	
	L	H	L	H	BA	CA, A9	Term Burst, start Read	3
	L	H	L	L	BA	CA, A9	Term Burst, new Write	3
	L	L	H	H	BA	RA	ILLEGAL	2
	L	L	H	L	BA	A9	Term Burst, execute Precharge	3
	L	L	L	×	×	×	ILLEGAL	

Function Truth Table (2/2)

Note 1

Current State	$\overline{CS}$	$\overline{RAS}$	$\overline{CAS}$	$\overline{WE}$	BA	Address	Action	Note
Read with Auto Precharge (RAP)	H	×	×	×	×	×	NOP (Continue Burst to End and enter Row Precharge)	
	L	H	H	H	×	×	NOP (Continue Burst to End and enter Row Precharge)	
	L	H	H	L	×	×	ILLEGAL	
	L	H	L	H	BA	CA, A9	ILLEGAL	
	L	H	L	L	BA	CA, A9	ILLEGAL	
	L	L	H	H	BA	RA	ILLEGAL	2
	L	L	H	L	BA	A9	ILLEGAL	2
	L	L	L	×	×	×	ILLEGAL	
Write with Auto Precharge (WAP)	H	×	×	×	×	×	NOP (Continue Burst to End and enter Row Precharge)	
	L	H	H	H	×	×	NOP (Continue Burst to End and enter Row Precharge)	
	L	H	H	L	×	×	ILLEGAL	
	L	H	L	H	BA	CA, A9	ILLEGAL	
	L	H	L	L	BA	CA, A9	ILLEGAL	
	L	L	H	H	BA	RA	ILLEGAL	2
	L	L	H	L	BA	A9	ILLEGAL	2
	L	L	L	×	×	×	ILLEGAL	
Precharging (PRE)	H	×	×	×	×	×	NOP → Idle after t_{RP}	
	L	H	H	H	×	×	NOP → Idle after t_{RP}	
	L	H	H	L	BA	×	ILLEGAL	2
	L	H	L	×	BA	CA, A9	ILLEGAL	2
	L	L	H	H	BA	A9	ILLEGAL	2
	L	L	H	L	BA	×	NOP	4
Refreshing (REF)	H	×	×	×	×	×	NOP → Idle after t_{RC}	
	L	H	H	H	×	×	NOP → Idle after t_{RC}	
	L	H	H	L	×	×	ILLEGAL	
	L	H	L	×	BA	CA, A9	ILLEGAL	
	L	L	H	H	BA	RA	ILLEGAL	
	L	L	H	L	BA	A9	ILLEGAL	
	L	L	L	×	×	×	ILLEGAL	

ABBREVIATIONS
BA = Bank Address RA = Row Address CA = Column Address
NOP = No Operation command

Notes: 1. All inputs are enabled when CKE is set high for at least 1 cycle prior to the inputs.
2. Illegal to bank in specified state, but may be legal in some cases depending on the state of bank selection.
3. To avoid bus contention, satisfy t_{CCD} and t_{DPL}.
4. NOP to bank precharging or in idle state. Precharges activated bank by BA or A9.
5. Illegal if any bank is not idle.

Function Truth Table for CKE

Current State (n)	CKEn-1	CKEn	$\overline{CS}$	$\overline{RAS}$	$\overline{CAS}$	$\overline{WE}$	Address	Action	Note
Self Refresh (SREF)	H	×	×	×	×	×	×	INVALID	
	L	H	H	×	×	×	×	Exit Self Refresh → ABI	
	L	H	L	H	H	H	×	Exit Self Refresh → ABI	
	L	H	L	H	H	L	×	ILLEGAL	
	L	H	L	H	L	×	×	ILLEGAL	
	L	H	L	L	×	×	×	ILLEGAL	
	L	L	×	×	×	×	×	NOP (Maintain Self Refresh)	
Power Down (PD)	H	×	×	×	×	×	×	INVALID	
	L	H	H	×	×	×	×	Exit Self Refresh → ABI	
	L	H	L	H	H	H	×	Exit Self Refresh → ABI	
	L	H	L	H	H	L	×	ILLEGAL	
	L	H	L	H	L	×	×	ILLEGAL	
	L	H	L	L	×	×	×	ILLEGAL	
	L	L	×	×	×	×	×	NOP (Continue power down mode)	
All Banks Idle (ABI)	H	H	×	×	×	×	×	Refer to Truth Table	6
	H	L	H	×	×	×	×	Enter Power Down	6
	H	L	L	H	H	H	×	Enter Power Down	6
	H	L	L	H	H	L	×	ILLEGAL	6
	H	L	L	H	L	×	×	ILLEGAL	6
	H	L	L	L	H	L	×	ILLEGAL	6
	H	L	L	L	L	H	×	Enter Self Refresh	6
	H	L	L	L	L	L	×	ILLEGAL	6
	L	L	×	×	×	×	×	NOP	6
Any State Other than Listed Above	H	H	×	×	×	×	×	Refer to Truth Table	
	H	L	×	×	×	×	×	Begin Clock Suspend Next Cycle	
	L	H	×	×	×	×	×	Enable Clock of Next Cycle	
	L	L	×	×	×	×	×	Continue Clock Suspension	

Note: 6. Power-down and self refresh can be entered only when all the banks are in an idle state.

Mode Set Address Keys

Operation Code			$\overline{CAS}$ Latency				Burst Type		Burst Length				
A8	A7	TM	A6	A5	A4	CL	A3	BT	A2	A1	A0	BT = 0	BT = 1
0	0	Mode Setting	0	0	0	Reserved	0	Sequential	0	0	0	1	Reserved
0	1	Vender Use Only	0	0	1	Reserved	1	Interleave	0	0	1	2	Reserved
1	0		0	1	0	2			0	1	0	4	4
1	1		0	1	1	3			0	1	1	8	8
Write Burst Length			1	0	0	Reserved			1	0	0	Reserved	Reserved
A9	Length		1	0	1	Reserved			1	0	1	Reserved	Reserved
0	Burst		1	1	0	Reserved			1	1	0	Reserved	Reserved
1	Single Bit		1	1	1	Reserved			1	1	1	Full Page	Reserved

POWER ON SEQUENCE

1. With CKE = "H", DQM = "H" and the other inputs in NOP state, turn on the power supply and start the system clock.
2. After the V_{CC} voltage has reached the specified level, pause for 200 μs or more with the input kept in NOP state.
3. Issue the precharge all bank command.
4. Apply an Auto-refresh 2 or more times.
5. Enter the mode register command.

Burst Length and Sequence

BL = 2

Starting Address (column address A0, binary)	Sequential Type	Interleave Type
0	0, 1	Not supported
1	1, 0	Not supported

BL = 4

Starting Address (column address A1, A0, binary)	Sequential Type	Interleave Type
00	0, 1, 2, 3	0, 1, 2, 3
01	1, 2, 3, 0	1, 0, 3, 2
10	2, 3, 0, 1	2, 3, 0, 1
11	3, 0, 1, 2	3, 2, 1, 0

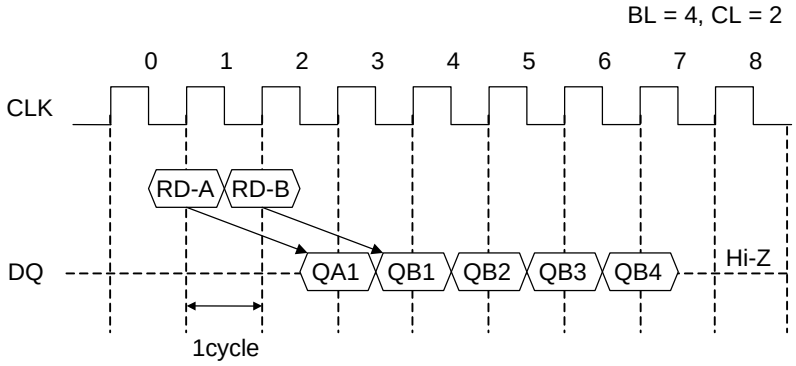
BL = 8

Starting Address (column address A2 to A0, binary)	Sequential Type	Interleave Type
000	0, 1, 2, 3, 4, 5, 6, 7	0, 1, 2, 3, 4, 5, 6, 7
001	1, 2, 3, 4, 5, 6, 7, 0	1, 0, 3, 2, 5, 4, 7, 6
010	2, 3, 4, 5, 6, 7, 0, 1	2, 3, 0, 1, 6, 7, 4, 5
011	3, 4, 5, 6, 7, 0, 1, 2	3, 2, 1, 0, 7, 6, 5, 4
100	4, 5, 6, 7, 0, 1, 2, 3	4, 5, 6, 7, 0, 1, 2, 3
101	5, 6, 7, 0, 1, 2, 3, 4	5, 4, 7, 6, 1, 0, 3, 2
110	6, 7, 0, 1, 2, 3, 4, 5	6, 7, 4, 5, 2, 3, 0, 1
111	7, 0, 1, 2, 3, 4, 5, 6	7, 6, 5, 4, 3, 2, 1, 0

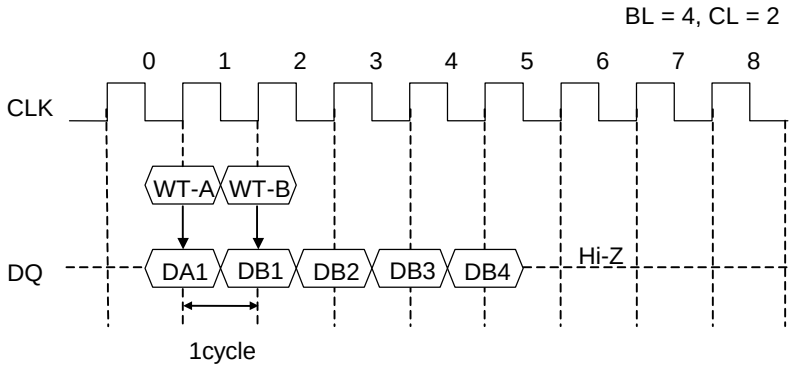
BL = Full: Sequential only

READ/WRITE COMMAND INTERVAL

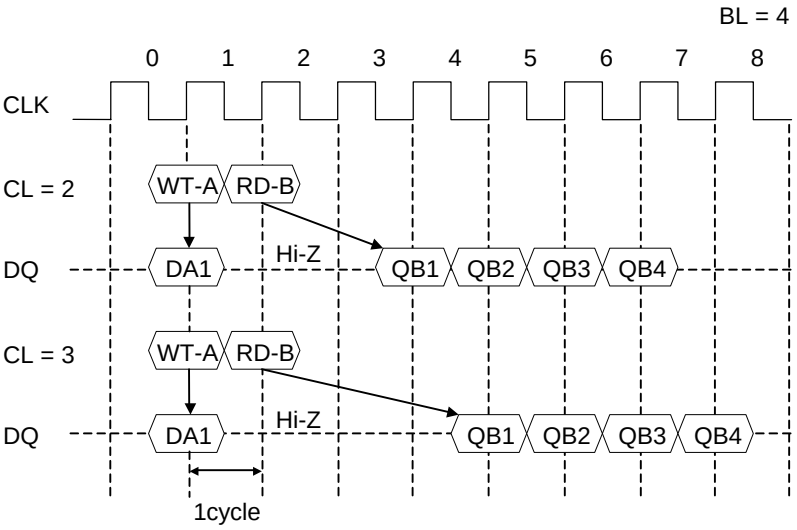
Read to Read Command Interval



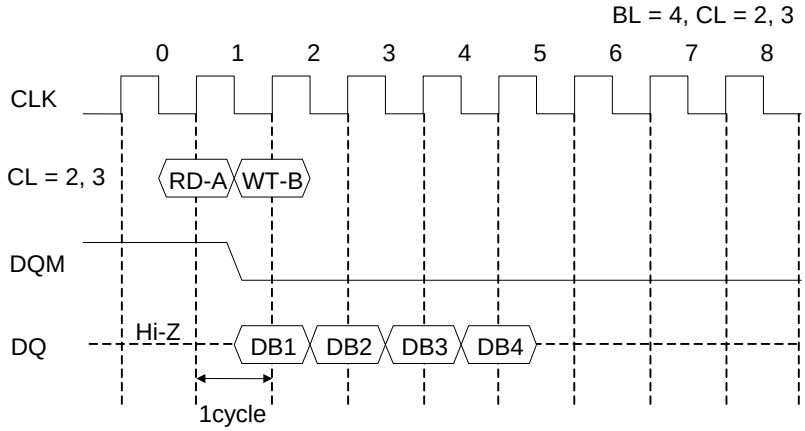
Write to Write Command Interval

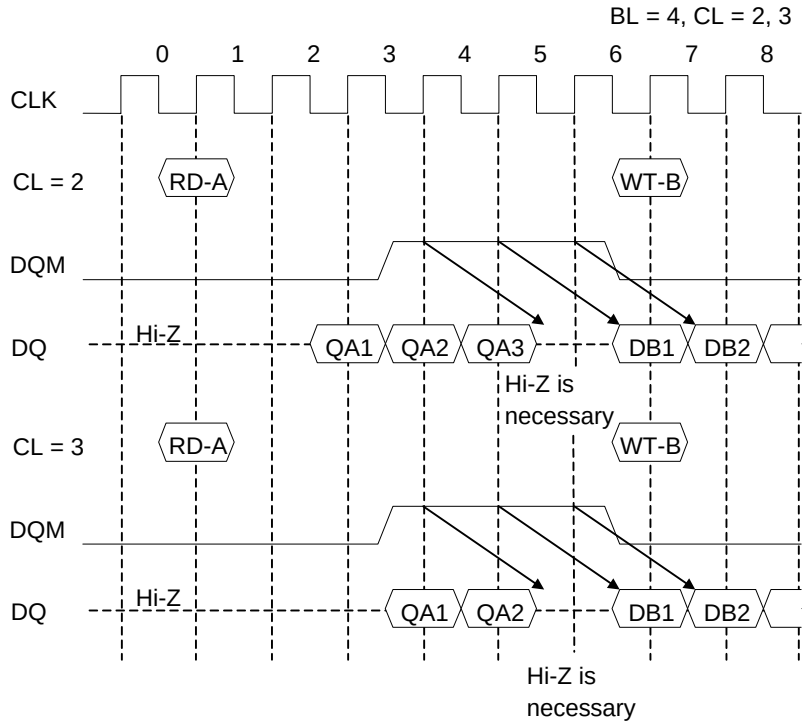


Write to Read Command Interval



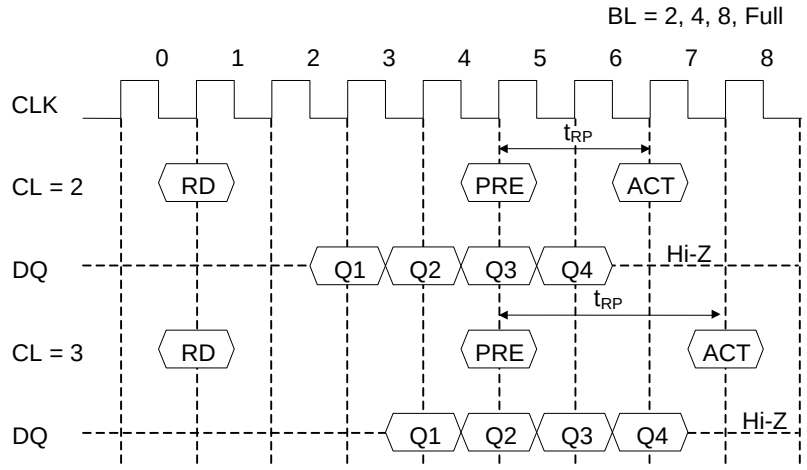
Read to Write Command Interval



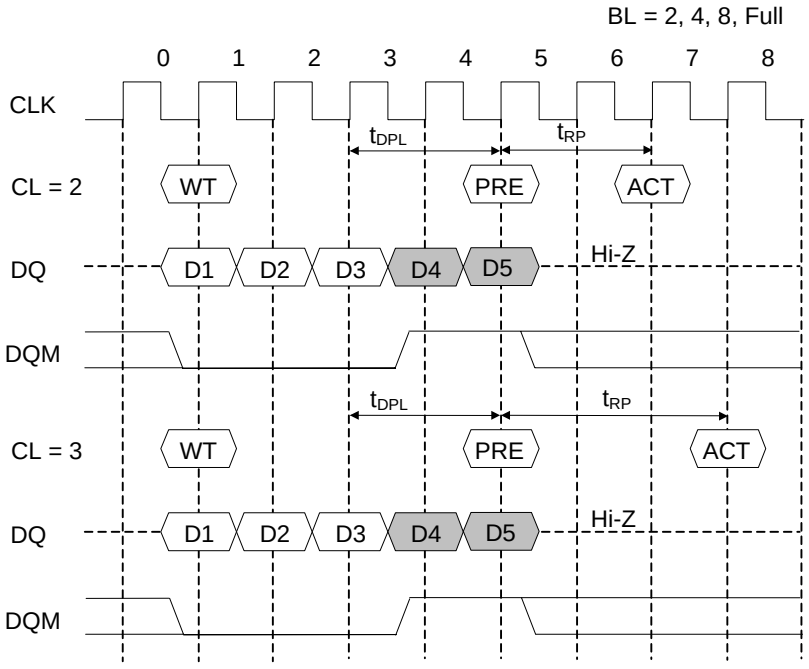


BURST TERMINATION

Burst Read Termination by Precharging in READ Cycle

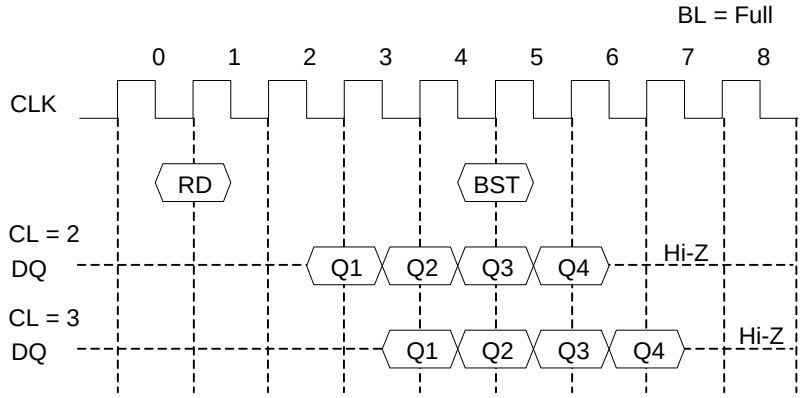


Burst Write Termination by Precharging in WRITE Cycle

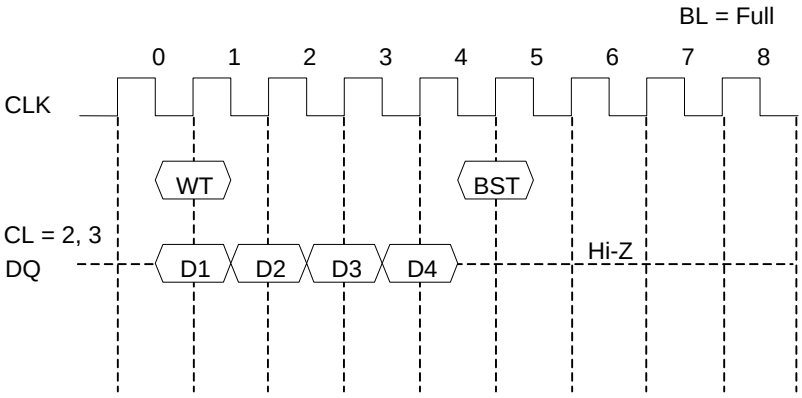


Note: The burst write operation is unfinished, the input data must be masked by means of DQM for assurance of the CLK by t_{DPL}.

Read Burst Stop Command

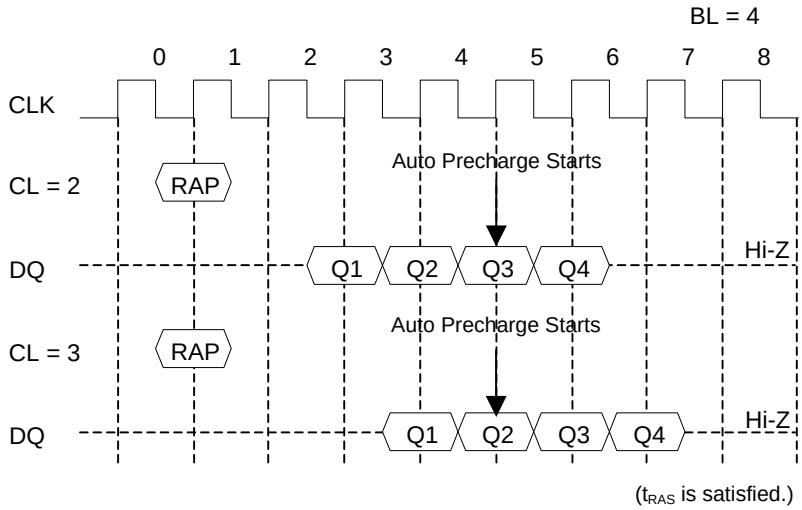


Write Burst Stop Command



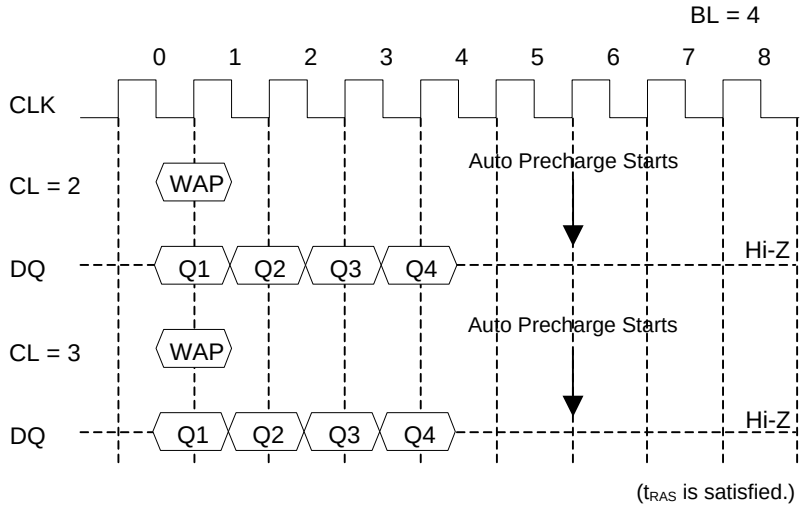
AUTO PRECHARGE

Read with Auto Precharge



(t_{RAS} is satisfied.)

Write with Auto Precharge



(t_{RAS} is satisfied.)

ELECTRICAL CHARACTERISTICS

Absolute Maximum Ratings

Parameter	Symbol	Rating	Unit
Voltage on Power Supply Pin Relative to GND	V_{CC}	–0.5 to 4.6	V
Voltage on Input Pin Relative to GND	V_{IN}, V_{OUT}	–0.5 to V_{CC} + 0.5 ≤ 4.6	V
Short Circuit Output Current	I_{OS}	50	mA
Power Dissipation	P_D*	1	W
Operating Temperature	T_{opr}	0 to 70	°C
Storage Temperature	T_{stg}	–55 to 150	°C

*: Ta = 25 °C

Caution: Exposing the device to stress above those listed in Absolute Maximum Ratings could cause permanent damage. The device is not meant to be operated under conditions outside the limits described in the operational section of this specification. Exposure to Absolute Maximum Ratings conditions for extended periods may affect device reliability.

Recommended Operating Conditions

(Ta = 0 to 70°C)

Parameter	Symbol	Min.	Typ.	Max.	Unit
Power Supply Voltage	V_{CC}	3.0	3.3	3.6	V
	V_{SS}	0	0	0	V
Input High Voltage	V_{IH}	2.0	—	V_{CC} + 0.3	V
Input Low Voltage	V_{IL}	–0.3	—	0.8	V

Capacitance

(V_{CC} = 3.3 V ±0.3 V, Ta = 25°C, f = 1 MHz)

Parameter	Symbol	Min.	Max.	Unit
Input Capacitance (A0 to A9, BA)	C_{IN1}*	—	5	pF
Input Capacitance (CLK, CKE, $\overline{CS}$, $\overline{RAS}$, $\overline{CAS}$, $\overline{WE}$ DQM0 to DQM3)	C_{IN2}*	—	5	pF
Output Capacitance (DQ0 to DQ31)	C_{OUT}*	—	6	pF

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

DC Characteristics

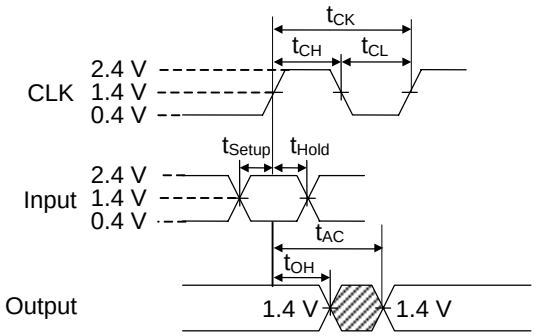
Parameter	Symbol	Test Condition		MS82V16520A-7		MS82V16520A-8		Unit	Note
		CKE	Other	Min.	Max.	Min.	Max.		
Output High Voltage	V_{OH}	—	I_{OH}= –2.0 mA	2.4	—	2.4	—	V	
Output Low Voltage	V_{OL}	—	I_{OL}= 2.0 mA	—	0.4	—	0.4	V	
Input Leakage Current	I_{LI}	—	—	–10	10	–10	10	μA	
Output Leakage Current	I_{LO}	—	—	–10	10	–10	10	μA	
Operating Current (1 Bank)	I_{CC1}	CKE ≥ V_{IH}	t_{CK} = min. t_{RC} = min. No Burst	—	190	—	170	mA	1, 2
Precharge Standby Current in Power Down Mode	I_{CC2P}	CKE ≤ V_{IL}	t_{CK} = min.	—	2	—	2	mA	3
	I_{CC2PS}	CKE ≤ V_{IL}	CLK ≤ V_{IL} t_{CK} = ∞	—	2	—	2	mA	2
Precharge Standby Current in Non Power Down Mode	I_{CC2N}	CKE ≥ V_{IH}	$\overline{CS}$ ≥ V_{IH} t_{CK} = min.	—	40	—	40	mA	2
	I_{CC2NS}	CKE ≥ V_{IH}	CLK ≤ V_{IL} t_{CK} = ∞	—	20	—	20	mA	
Active Standby Current in Power Down Mode	I_{CC3P}	CKE ≤ V_{IL}	t_{CK} = min.	—	3	—	3	mA	3
	I_{CC3PS}	CKE ≤ V_{IL}	CLK ≤ V_{IL} t_{CK} = ∞	—	3	—	3	mA	3
Active Standby Current in Non Power Down Mode	I_{CC3N}	CKE ≥ V_{IH}	$\overline{CS}$ ≥ V_{IH} t_{CK} = min.	—	50	—	50	mA	3
	I_{CC3NS}	CKE ≥ V_{IH}	CLK ≤ V_{IL} t_{CK} = ∞	—	30	—	30	mA	3
Operating Current (Burst Mode)	I_{CC4}	CKE ≥ V_{IH}	t_{CK} = min.	—	240	—	200	mA	1, 2
Refresh Current	I_{CC5}	CKE ≥ V_{IH}	t_{RC} ≥ min.	—	170	—	150	mA	
Self Refresh Current	I_{CC6}	CKE ≤ 0.2V	—	—	3	—	3	mA	

Notes 1. The maximum value of power supply current is obtained with the output open.
2. Address and data are changed only one time during one cycle.
3. Address and data are changed only one time during two cycles.

AC Characteristics

Test conditions

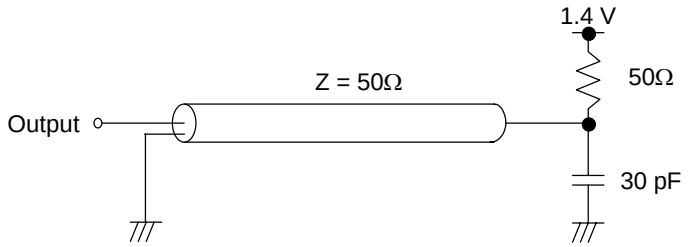
- AC measurements assume t_T = 1 ns.
- Reference level for measuring timing of input signals is 1.4 V. Transition times are measured between V_{IH} and V_{IL}.
- If t_T is longer than 1 ns, reference level for measuring timing of input signals is $V_{IH\ (MIN.)}$ and $V_{IL\ (MAX)}$.
- An access time is measured at 1.4 V.
- Input levels at the AC testing are 2.4 V/0.4 V.



Synchronous Characteristics

Parameter		Symbol	MS82V16520A-7		MS82V16520A-8		Unit	Note
			Min.	Max.	Min.	Max.		
Clock Cycle Time	$\overline{CAS}$ Latency = 3	t_{CK3}	7	—	8	—	ns	
	$\overline{CAS}$ Latency = 2	t_{CK2}	10	—	12	—	ns	
Access Time from CLK	$\overline{CAS}$ Latency = 3	t_{AC3}	—	6	—	6.5	ns	1
	$\overline{CAS}$ Latency = 2	t_{AC2}	—	8	—	9	ns	1
CLK High Level Width		t_{CH}	2.5	—	3	—	ns	
CLK Low Level Width		t_{CL}	2.5	—	3	—	ns	
Data-out Hold Time		t_{OH}	2	—	2	—	ns	
Data-out Low-impedance Time		t_{LZ}	0	—	0	—	ns	
Data-out High-impedance Time		t_{HZ}	—	5	—	6	ns	
Data-in Setup Time		t_{DS}	2	—	2.5	—	ns	
Data-in Hold Time		t_{DH}	1	—	1	—	ns	
Address Setup Time		t_{AS}	2	—	2.5	—	ns	
Address Hold Time		t_{AH}	1	—	1	—	ns	
CKE Setup Time		t_{CKS}	2	—	2.5	—	ns	
CKE Hold Time		t_{CKH}	1	—	1	—	ns	
Command ($\overline{CS}$, $\overline{RAS}$, $\overline{CAS}$, $\overline{WE}$, DQM) Setup Time		t_{CMS}	2	—	2.5	—	ns	
Command ($\overline{CS}$, $\overline{RAS}$, $\overline{CAS}$, $\overline{WE}$, DQM) Hold Time		t_{CMH}	1	—	1	—	ns	

Note 1. Output load.

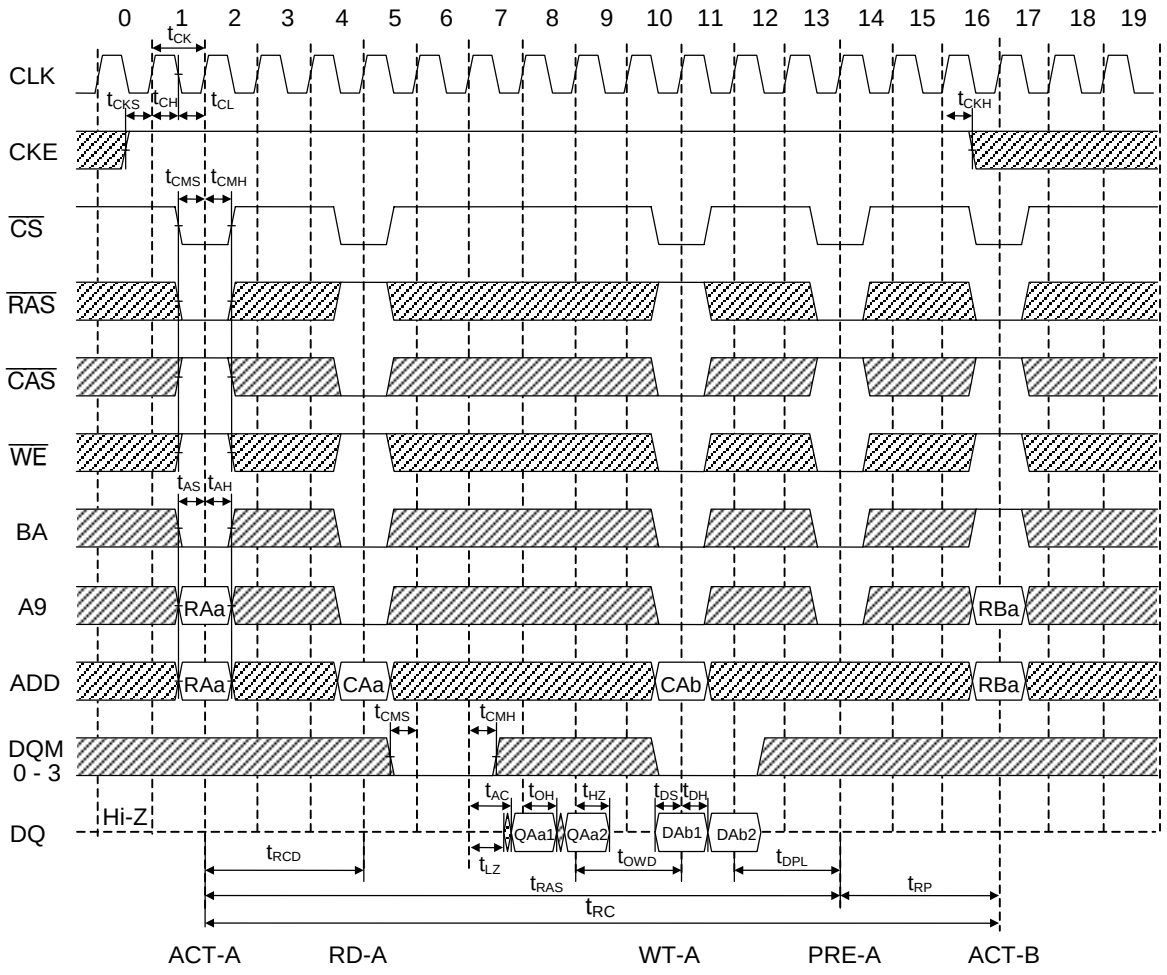


Asynchronous Characteristics

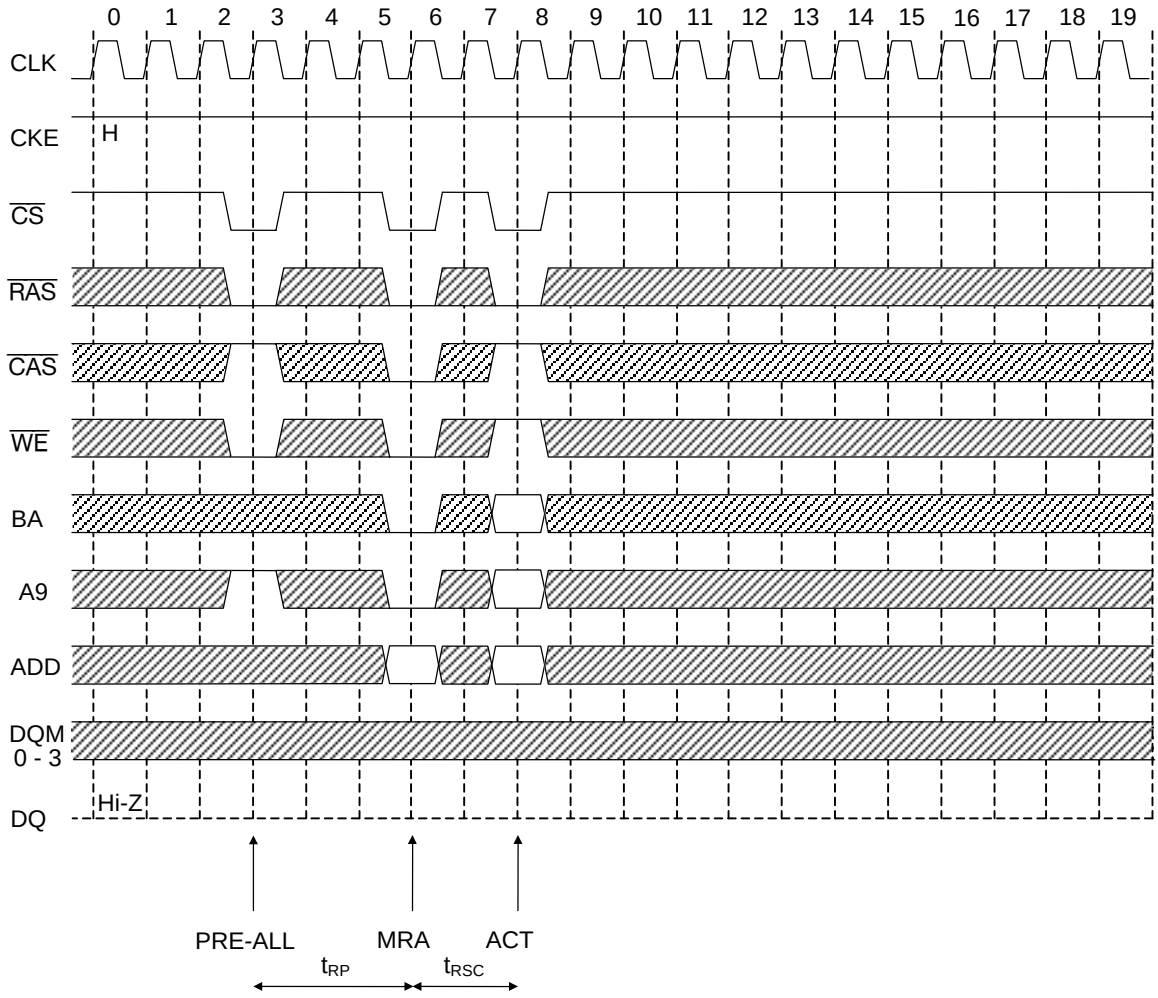
Parameter	Symbol	MS82V16520A-7		MS82V16520A-8		Unit	Note
		Min.	Max.	Min.	Max.		
REF to REF/ACT Command Period	t_{RC}	63	—	72	—	ns	
ACT to PRE Command Period	t_{RAS}	42	120k	48	120k	ns	
PRE to ACT Command Period	t_{RP}	21	—	24	—	ns	
Delay Time ACT to READ/WRITE Command	t_{RCD}	21	—	24	—	ns	
ACT (A) to ACT (B) Command Period	t_{RRD}	14	—	16	—	ns	
READ/WRITE to READ/WRITE Command Period	t_{CCD}	7	—	8	—	ns	
Data-in to PRE Command Period	t_{DPL}	14	—	16	—	ns	
Data Output to WRITE Command Input Time	t_{OWD}	14	—	16	—	ns	
Mode Register Set Cycle Time	t_{RSC}	14	—	16	—	ns	
Transition Time	t_T	1	30	1	30	ns	
Refresh Time	t_{REF}	—	32	—	32	ms	

TIMING WAVEFORM

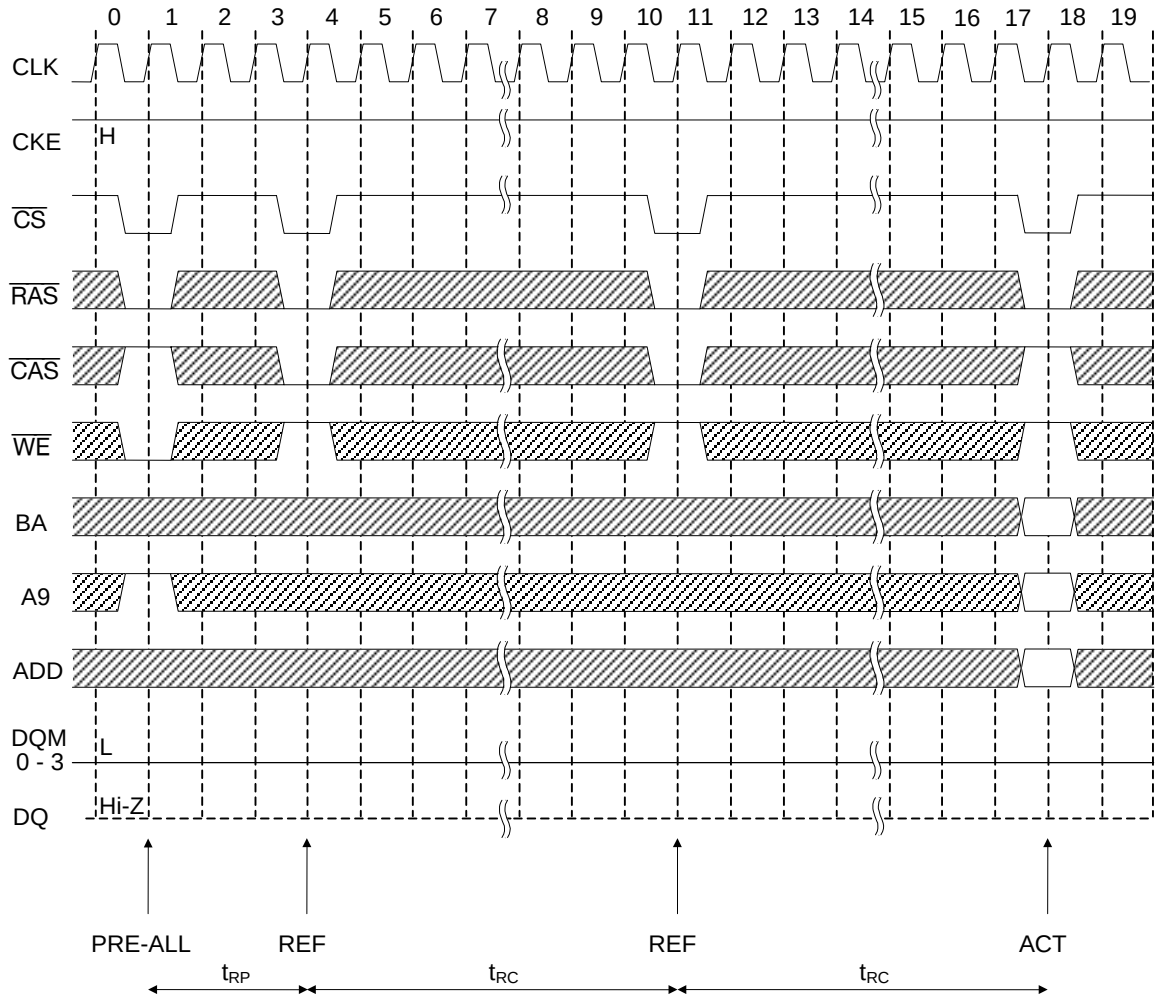
READ/WRITE Cycle (BL = 2, CL = 3)



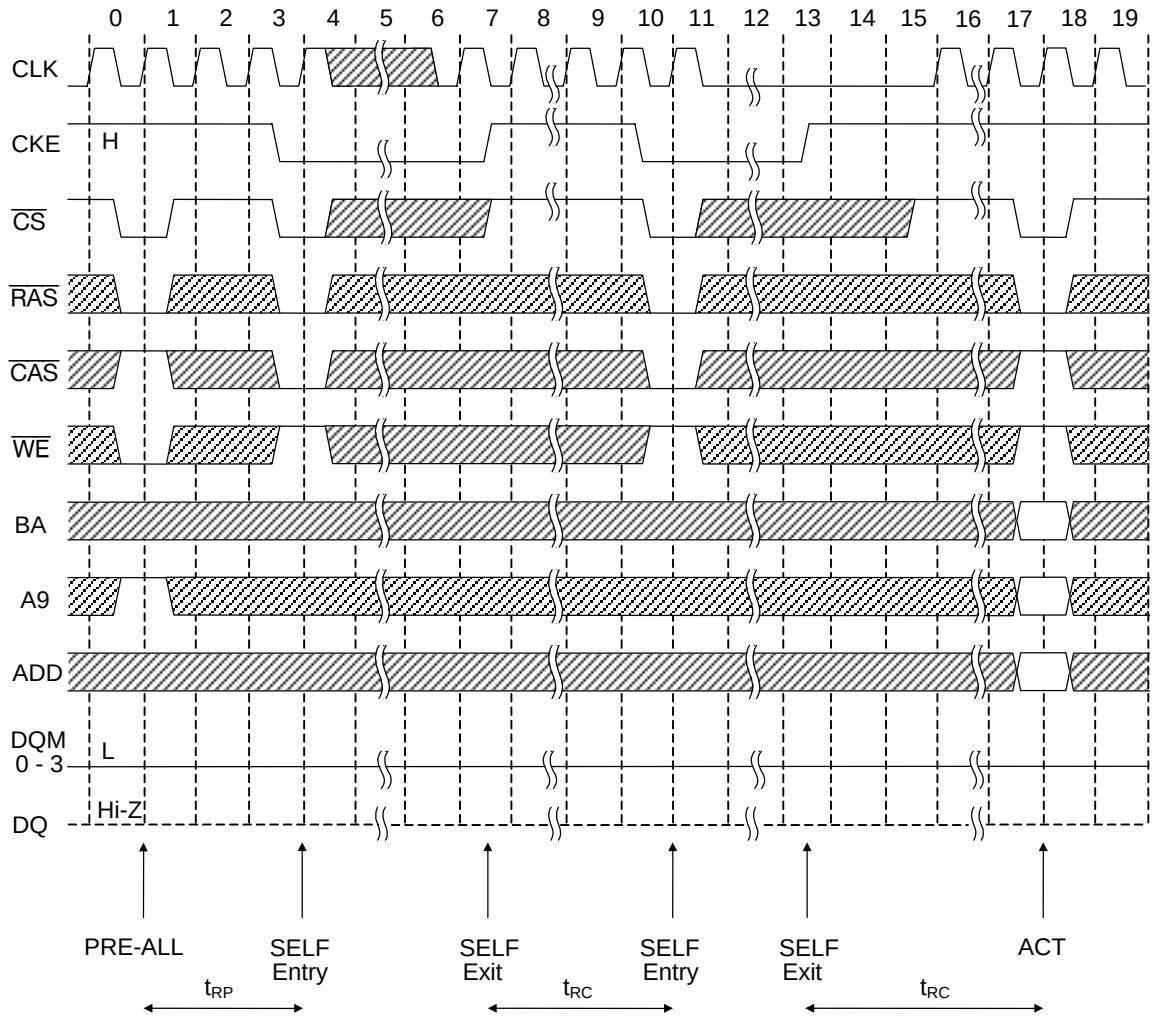
Mode Register Set



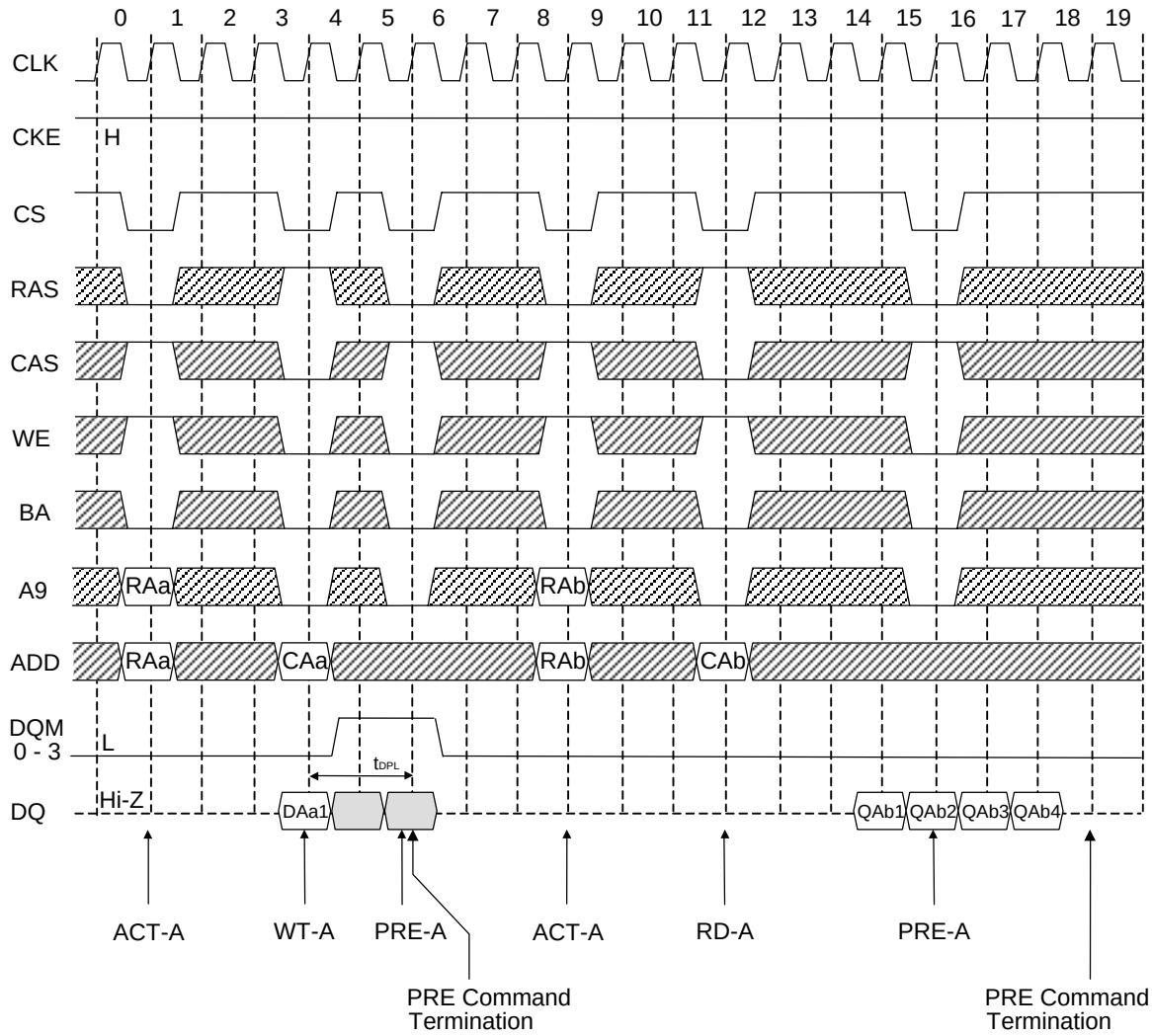
Auto Refresh



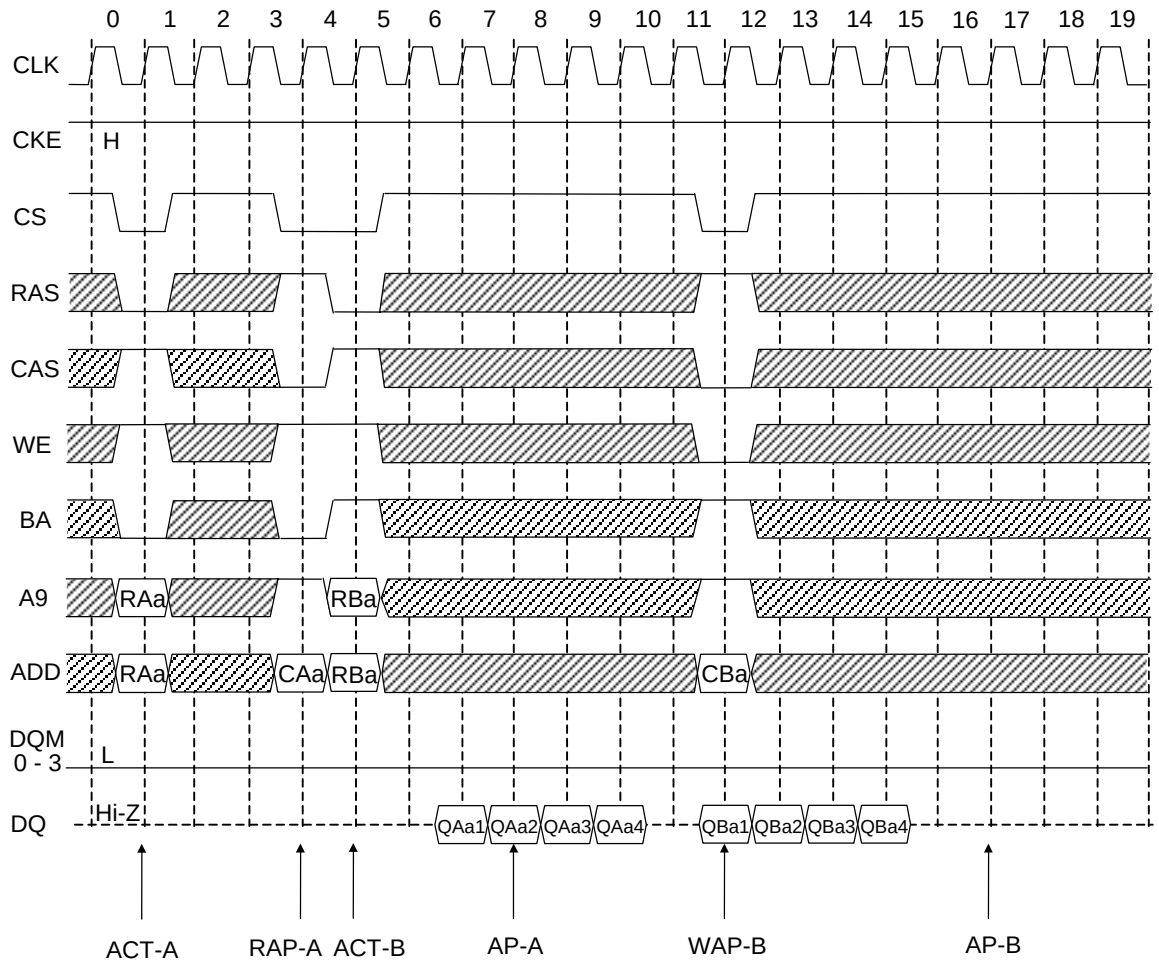
Self Refresh (Entry and Exit)



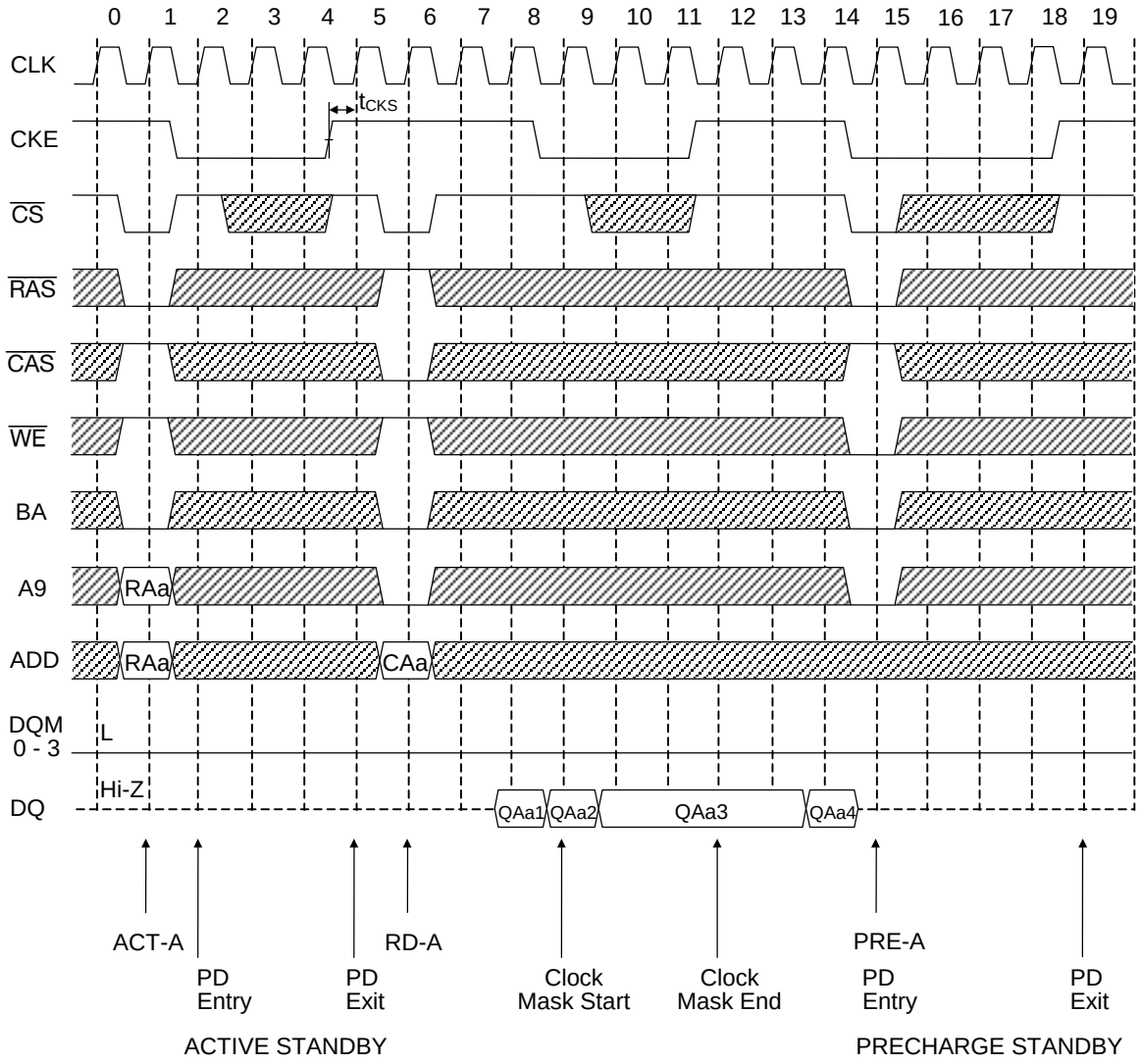
Burst Termination by Precharging (BL = 8, CL = 3)



Auto Precharge (BL = 4, CL = 3)

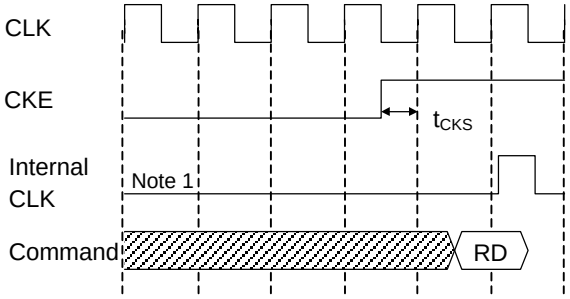


Power Down Mode and Clock Suspension (BL = 4, CL = 2)

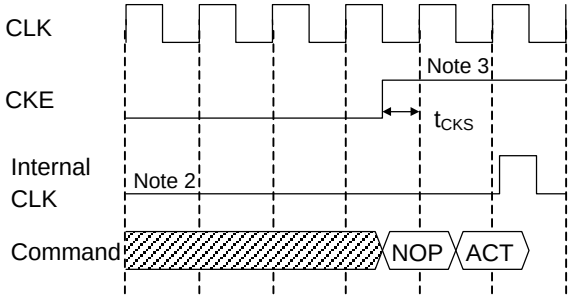


CLOCK Suspend Exit & Power Down Exit

1) Clock Suspend (= Active Power Down) Exit

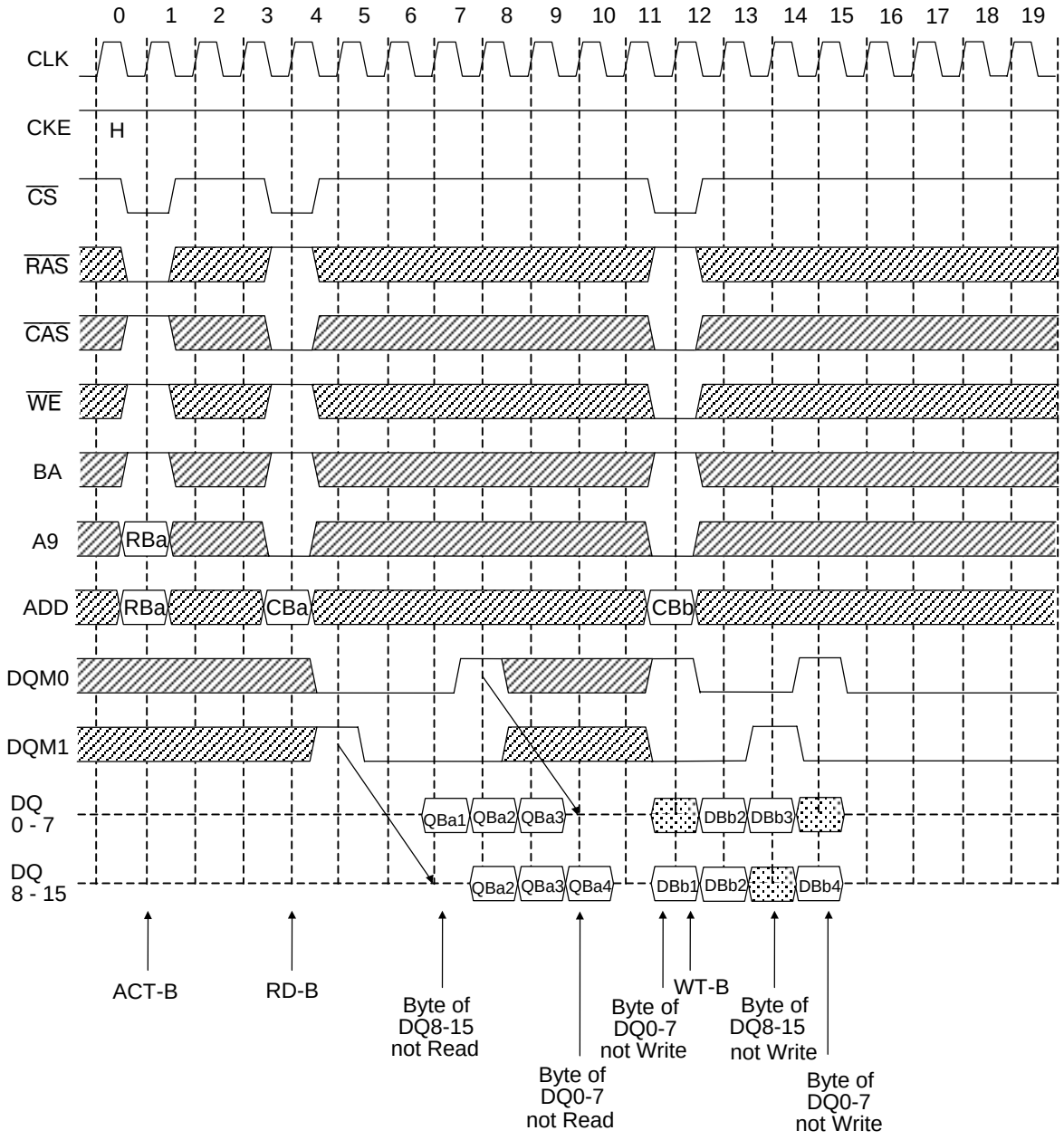


2) Power Down (= Precharge Power Down) Exit

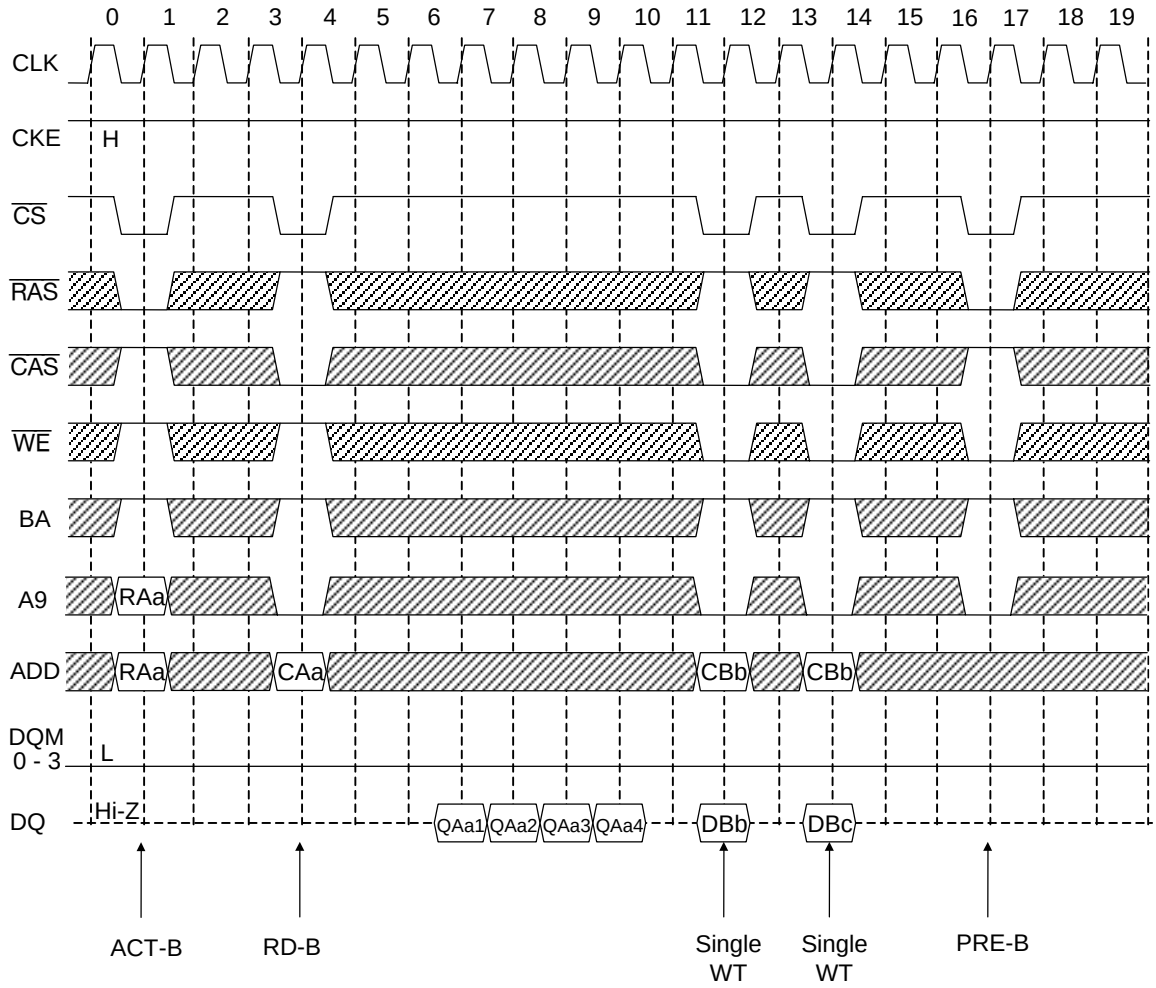


Notes: 1. Active power down: one or both bank active state.
2. Precharge power down: both bank precharge state.
3. NOP should be issued. And new command can be issued after 1 Clock.

Byte Read/Write Operation (by DQM) (BL = 4, CL = 3)

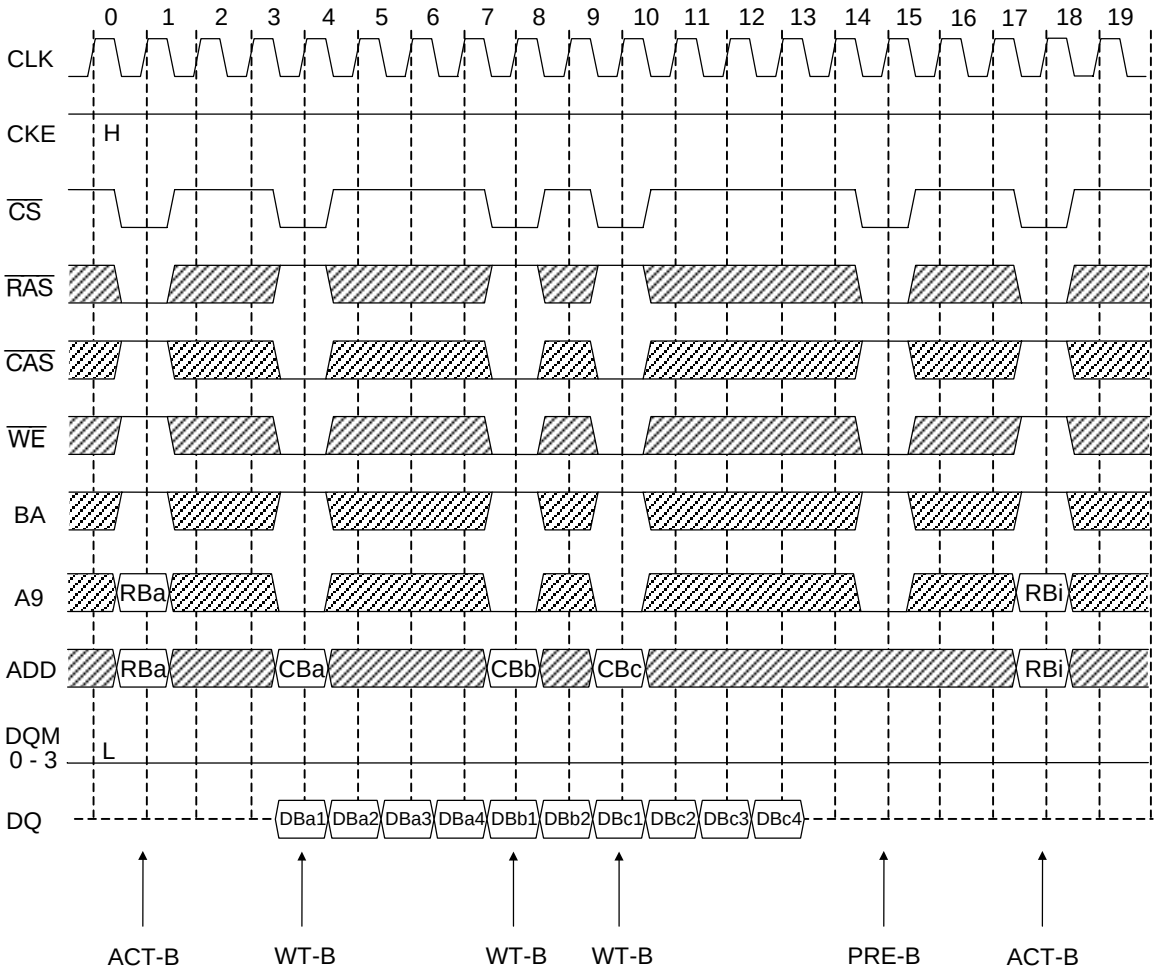


Burst Read and Single Write (BL = 4, CL = 3)

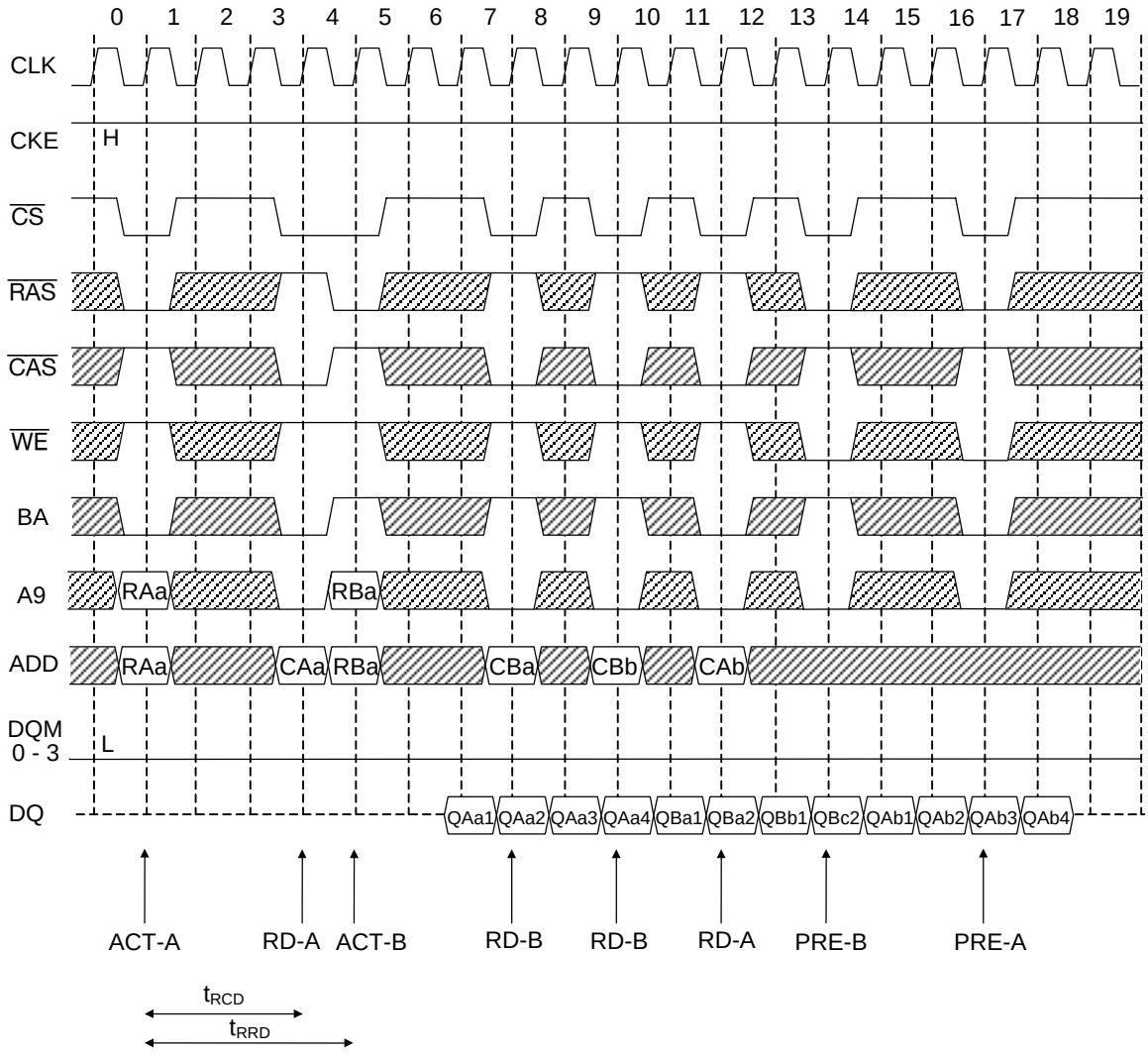


Random Column Read (Continuous Read of Same Bank) (BL = 4, CL = 3)

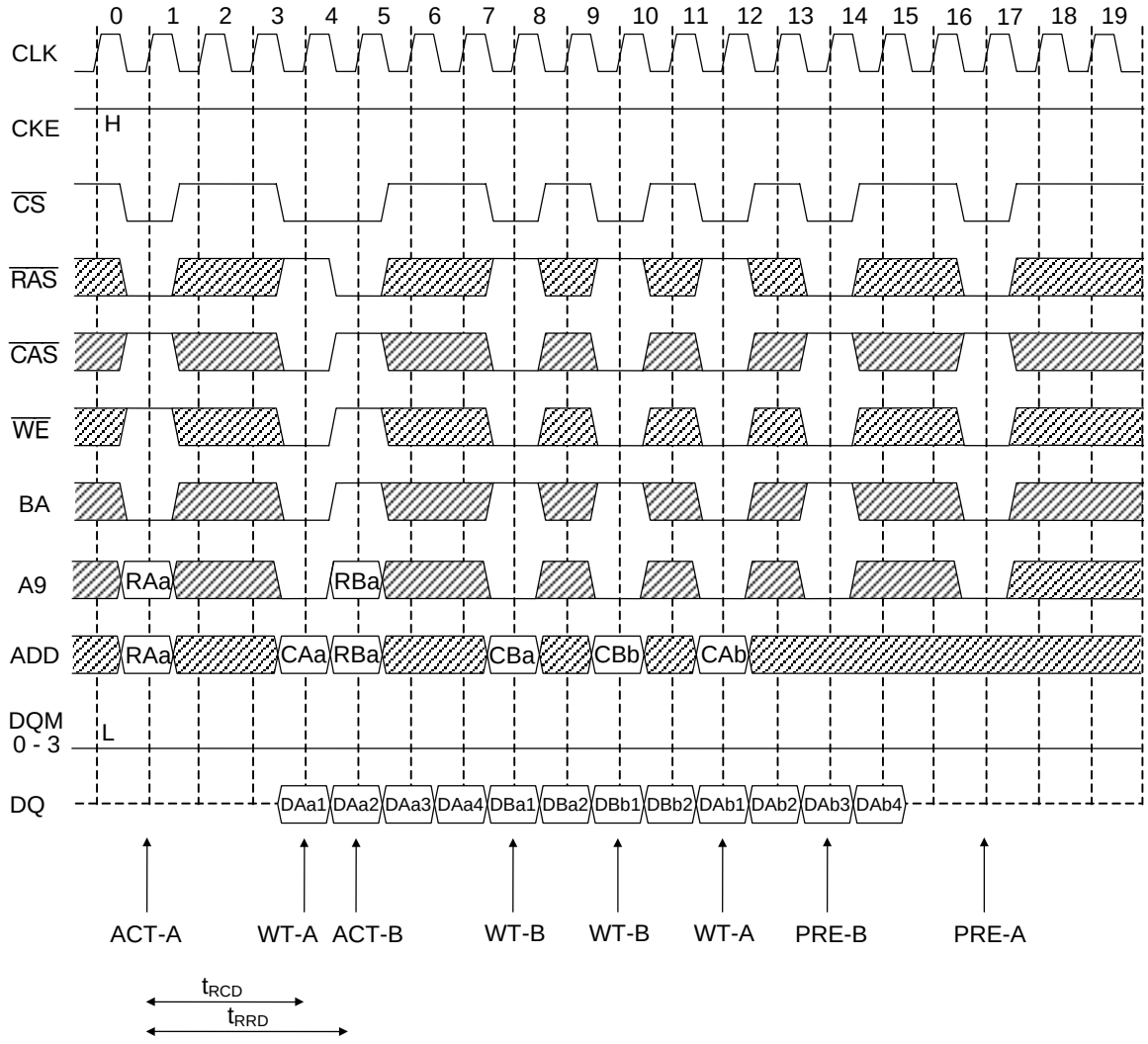
Random Column Write (Continuous Write of Same Bank) (BL = 4, CL = 3)



Interleaved Column Read (BL = 4, CL = 3)



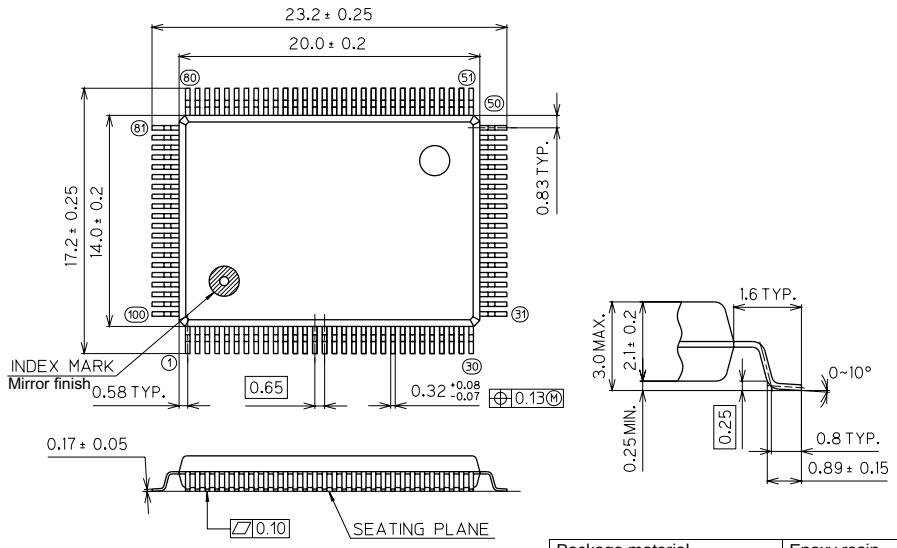
Interleaved Column Write (BL = 4, CL = 3)



PACKAGE DIMENSIONS

(Unit: mm)

QFP100-P-1420-0.65-BK4



Package material	Epoxy resin
Lead frame material	42 alloy
Pin treatment	Solder plating (≥5µm)
Package weight (g)	1.54 TYP.
Rev. No./Last Revised	4/Nov. 28, 1996

Oki Electric Industry Co., Ltd.

Notes for Mounting the Surface Mount Type Package

The surface mount type packages are very susceptible to heat in reflow mounting and humidity absorbed in storage.
Therefore, before you perform reflow mounting, contact Oki's responsible sales person for the product name, package name, pin number, package code and desired mounting conditions (reflow method, temperature and times).

REVISION HISTORY

Document No.	Date	Page		Description
		Previous Edition	Current Edition	
PEDS82V16520A-01	Nov. 2001	–	–	Preliminary first edition
PEDS82V16520A-02	Apr. 26, 2002	1	1	Changed the subtitle from "2262,144-Word × 32-Bit × 2-Bank SDRAM" to "262,144-Word × 32-Bit × 2-Bank SGRAM".
		4	4	Changed the table in "PRODUCT FAMILY"
				Changed Note 3 to Note 4 and added Note 3.
		5	5	Added symbol "CKE" in headers "Auto Refresh Command" and "Self Refresh Entry/Exit Command". Added Section "Write with Auto Precharge Command ($\overline{CS}$, $\overline{CAS}$, $\overline{WE}$ = "Low", $\overline{RAS}$, A9 = "High").
		6	6	Added Sections "Read with Auto Precharge Command ($\overline{CS}$, $\overline{CAS}$ = "Low", $\overline{RAS}$, $\overline{WE}$, A9 = "High") and "Burst Stop Command ($\overline{CS}$, $\overline{WE}$ = "Low", $\overline{RAS}$, $\overline{CAS}$ = "High").
		7	7	Added the contents of Functions "Read with Auto Precharge" and "Write with Auto Precharge".
		8	8	Partially changed the contents of Column "Address".
		8	9	Current State "Precharging (PRE)" has been moved to page 9 and changed partially.
		9	9	Added Current States "Read with Auto Pre-charge (RAP)" and "Write with Auto Pre-charge (WAP)".
				Partially changed the content of Column "Address" in Current State "Refreshing (REF)".
		11	11	Partially changed the content of POWER ON SEQUENCE 4.
		15	15	Changed the heading from "Burst Read Termination ---" to "Burst Write Termination ---" and partially changed the timing diagram. Changed the content of Note.
		16	16	Changed "BL = 2, 4, 8, Full" to "BL = Full" in two diagrams.
		–	17	Added Section "AUTO PRECHARGE".
		17	18	Added Sentences shown with "Caution" in the Absolute Maximum Ratings section. Added asterisks "*" in the symbol column in the table of the Capacitance section and added the sentence shown with asterisk "*".

Document No.	Date	Page		Description
		Previous Edition	Current Edition	
PEDS82V16520A-02	Apr. 26, 2002	18	19	Changed a family device name from MS82V 16520A-10 to MS82V16520A-7 shown in the table and added related values.
				Partially changed Max. values of MS82V 16520A-75 and MS82V16520A-8.
				Partially changed Test Condition “Other” of Symbols I_{CC2N}, I_{CC3P}, and I_{CC3N}. Added 1 in Column “Note” of Symbol I_{CC4}.
		20	21	Changed a family device name from MS82V 16520A-10 to MS82V16520A-7 shown in the table and added related values.
				Partially changed Max. and Min. values of MS82V16520A-75 and MS82V16520A-8.
		21	22	Changed a family device name from MS82V 16520A-10 to MS82V16520A-7 shown in the table and added related values.
				Change the Min. values of Symbol t_{DPL}.
		26	27	Changed timings of DQM and DQ between CLK pulses 4 and 6.
		–	28	Added Section “Auto Prechaged (BL = 4, CL = 3)”.
FEDS82V16520A-01	Jun. 25, 2002	–	–	First edition
		1	1	Partially changed the table of “PRODUCT FAMILY” Partially changed the content of “Package” in the FEATURES section.
		19,21,22	19,21,22	Partially changed the tables of “DC Characteristics”, “Synchronous Characteristics”, and “Asynchronous Characteristics”.

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2. The outline of action and examples for application circuits described herein have been chosen as an explanation for the standard action and performance of the product. When planning to use the product, please ensure that the external conditions are reflected in the actual circuit, assembly, and program designs.

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