



DESCRIPTION

Preliminary

THE Hyundai HY57V161610D is a 16,777,216-bits CMOS Synchronous DRAM, ideally suited for the main memory applications which require large memory density and high bandwidth. HY57V161610D is organized as 2banks of 524,288x16.

HY57V161610D is offering fully synchronous operation referenced to a positive edge clock. All inputs and outputs are synchronized with the rising edge of the clock input. The data paths are internally pipelined to achieve very high bandwidth. All input and output voltage levels are compatible with LVTTTL.

Programmable options include the length of pipeline (Read latency of 1, 2, or 3), the number of consecutive read or write cycles initiated by a single control command (Burst length of 1, 2, 4, 8, or full page), and the burst count sequence(sequential or interleave). A burst of read or write cycles in progress can be terminated by a burst terminate command or can be interrupted and replaced by a new burst read or write command on any cycle. (This pipeline design is not restricted by a '2N' rule.)

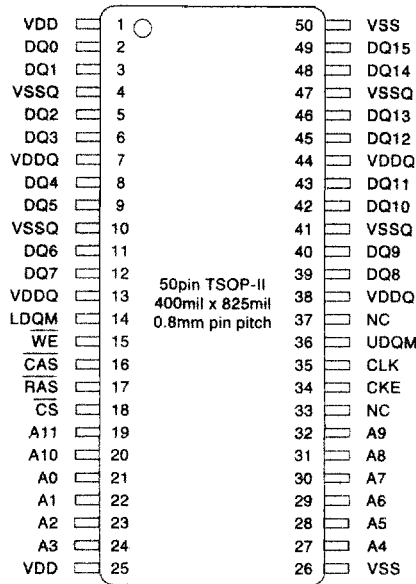
FEATURES

- Single 3.3V ± 0.3V power supply
- All device pins are compatible with LVTTTL interface
- JEDEC standard 400mil 50pin TSOP-II with 0.8mm of pin pitch
- All inputs and outputs referenced to positive edge of system clock
- Data mask function by UDQM/LDQM
- Internal two banks operation
- Auto refresh and self refresh
- 4096 refresh cycles / 64ms
- Programmable Burst Length and Burst Type
 - 1, 2, 4, 8 and Full Page for Sequence Burst
 - 1, 2, 4 and 8 for Interleave Burst
- Programmable CAS Latency ; 1, 2, 3 Clocks

ORDERING INFORMATION

Part No.	Clock Frequency	Organization	Interface	Package
HY57V161610DTC-8	125MHz	2Banks x 512Kbits x 16	LVTTTL	400mil 50pin TSOP II
HY57V161610DTC-10P	100MHz			
HY57V161610DTC-10S	100MHz			
HY57V161610DTC-10	100MHz			
HY57V161610DLTC-8	125MHz			
HY57V161610DLTC-10P	100MHz			
HY57V161610DLTC-10S	100MHz			
HY57V161610DLTC-10	100MHz			

PIN CONFIGURATION

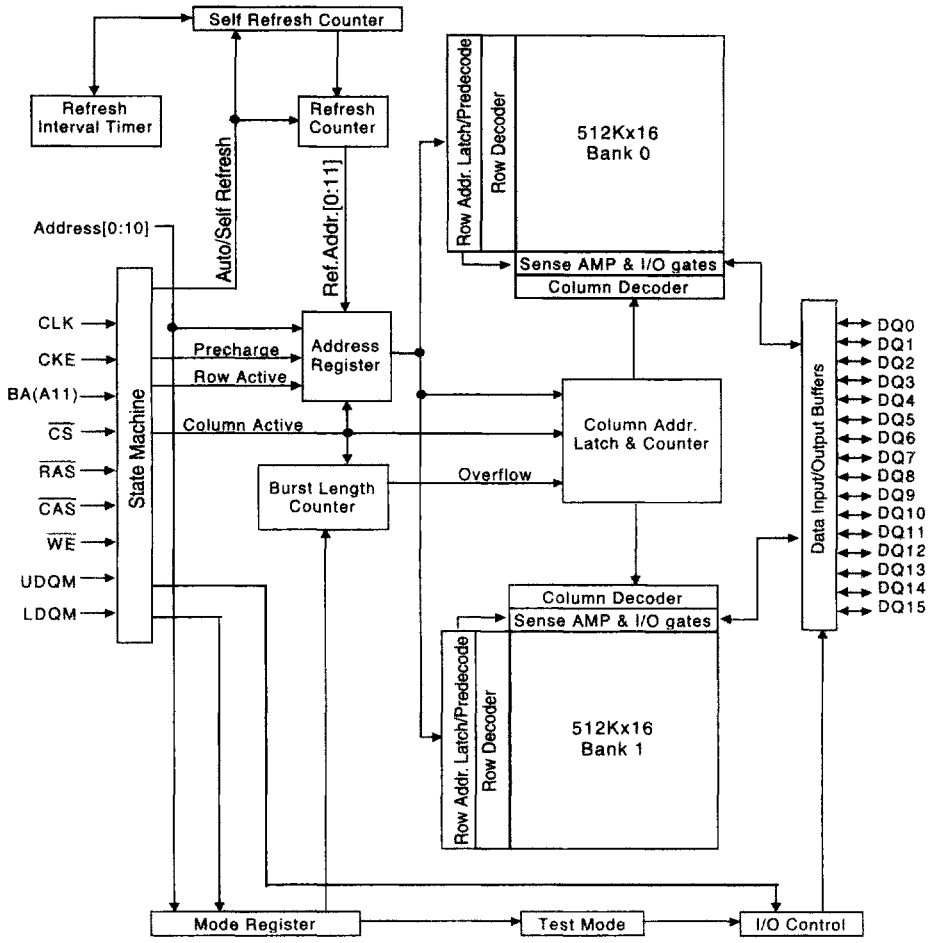


PIN DESCRIPTION

PIN	PIN NAME	DESCRIPTION
CLK	Clock	The system clock input. All other inputs are referenced to the SDRAM on the rising edge of CLK.
CKE	Clock Enable	Controls internal clock signal and when deactivated, the SDRAM will be one of the states among power down, suspend or self refresh.
\overline{CS}	Chip Select	Command input enable or mask except CLK, CKE and DQM
BA	Bank Address	Select either one of banks during both \overline{RAS} and \overline{CAS} activity.
A0 ~ A10	Address	Row Address : RA0 ~ RA10, Column Address : CA0 ~ CA7 Auto-precharge flag : A10
\overline{RAS} , \overline{CAS} , WE	Row Address Strobe, Column Address Strobe, Write Enable	\overline{RAS} , \overline{CAS} and WE define the operation. Refer function truth table for details
LDQM, UDQM	Data Input/Output Mask	DQM control output buffer in read mode and mask input data in write mode
DQ0 ~ DQ15	Data Input/Output	Multiplexed data input / output pin
VDD/VSS	Power Supply/Ground	Power supply for internal circuit and input buffer
VDDQ/VSSQ	Data Output Power/Ground	Power supply for DQ
NC	No Connection	No connection

FUNCTIONAL BLOCK DIAGRAM

1Mx16 Synchronous DRAM



ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Rating	Unit
Ambient Temperature	TA	0 ~ 70	°C
Storage Temperature	TSTG	-55 ~ 125	°C
Voltage on Any Pin relative to VSS	VIN, VOUT	-1.0 ~ 4.6	V
Voltage on VDD relative to VSS	VDD	-1.0 ~ 4.6	V
Short Circuit Output Current	IOS	50	mA
Power Dissipation	PD	1	W
Soldering Temperature · Time	TSOLDER	260·10	°C·Sec

Note : Operation at above absolute maximum rating can adversely affect device reliability.

DC OPERATING CONDITION (TA=0°C to 70°C)

Parameter	Symbol	Min	Typ.	Max	Unit	Note
Power Supply Voltage	VDD, VDDO	3.0	3.3	3.6	V	1
Input high voltage	VIH	2.0	3.0	VDD + 0.3	V	1, 2
Input low voltage	VIL	-0.5	0	0.8	V	1, 3

Note :

- All voltages are referenced to VSS = 0V.
- VIH(max) is acceptable 4.6V AC pulse width with ≤ 10ns of duration.
- VIL(max) is acceptable -1.5V AC pulse width with ≤ 10ns of duration.

AC OPERATING CONDITION (TA=0°C to 70°C, VDD=3.3V ± 0.3V, VSS=0V)

Parameter	Symbol	Value	Unit	Note
AC input high / low level voltage	VIH / VIL	2.4/0.4	V	
Input timing measurement reference level voltage	Vtrip	1.4	V	
Input rise / fall time	tR / tF	1	ns	
Output timing measurement reference level	Voutref	1.4	V	
Output load capacitance for access time measurement	CL	50	pF	1

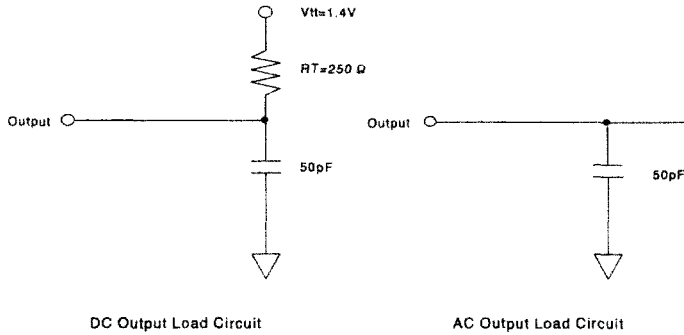
Note :

- Output load to measure access times is equivalent to two TTL gates and one capacitance(50pF).
For details, refer to AC/DC output load circuit.

CAPACITANCE (TA=25°C, f=1MHz)

Parameter	Pin	Symbol	Min	Max	Unit
Input capacitance	CLK	C11	2.5	4	pF
	A0 ~ A10, BA, CKE, CS, RAS, CAS, WE, UDQM, LDQM	C12	2.5	5	pF
Data input / output capacitance	DQ0 ~ DQ15	C1/O	4	6.5	pF

OUTPUT LOAD CIRCUIT



DC CHARACTERISTICS I (TA=0°C to 70°C, VDD=3.3V ± 0.3V)

Parameter	Symbol	Min.	Max	Unit	Note
Input leakage current	IL	-1	1	uA	1
Output leakage current	IO	-1	1	uA	2
Output high voltage	VOH	2.4	-	V	IOH = -4mA
Output low voltage	VOL	-	0.4	V	IOL = +4mA

Note :
 1. VIN = 0 to 3.6V, All other pins are not under test = 0V
 2. DOUT is disabled, VOUT=0 to 3.6V

DC CHARACTERISTICS II (TA=0°C to 70°C, VDD=3.3V ± 0.3V, VSS=0V)

Parameter	Symbol	Test Condition	Speed				Unit	Note	
			-8	-10P	-10S	-10			
Operating Current	IDD1	Burst Length=1, One bank active tRAS ≥ tRAS(min), tRP ≥ tRP(min), IO=0mA	110	110	110	90	mA	1	
Precharge Standby Current in power down mode	IDD2P	CKE ≤ VIL(max), tCK = min.	1				mA		
	IDD2PS	CKE ≤ VIL(max), tCK = ∞	1						
Precharge Standby Current in non power down mode	IDD2N	CKE ≥ VIH(min), CS ≥ VIH(min), tCK = min Input signals are changed one time during 2CLKs. All other pins ≥ VDD-0.2V or ≤ 0.2V	20				mA		
	IDD2NS	CKE ≥ VIH(min), tCK = ∞ Input signals are stable.	15						
Active Standby Current in power down mode	IDD3P	CKE ≤ VIL(max), tCK = min	30				mA		
	IDD3PS	CKE ≤ VIL(max), tCK = ∞	30						
Active Standby Current in non power down mode	IDD3N	CKE ≥ VIH(min), CS ≥ VIH(min), tCK = min Input signals are changed one time during 2CLKs. All other pins ≥ VDD-0.2V or ≤ 0.2V	50				mA		
	IDD3NS	CKE ≥ VIH(min), tCK = ∞ Input signals are stable.	30						
Burst Mode Operating Current	IDD4	tCK ≥ tCK(min), tRAS ≥ tRAS(min), IO=0mA All banks active	CL=3	110	90	90	75	mA	1
			CL=2	90	75	75	65		
Auto Refresh Current	IDD5	tRRC ≥ tRRC(min), All banks active	110	110	110	90	mA		
Self Refresh Current	IDD6	CKE ≤ 0.2V	2				mA	2	
			400				uA	3	

Note :

1. IDD1 and IDD4 depend on output loading and cycle rates. Specified values are measured with the output open.
2. HY57V161610DTC-8/10P/10S/10
3. HY57V161610DLTC-8/10P/10S/10

AC CHARACTERISTICS I

Parameter		Symbol	-8		-10P		-10S		-10		Unit	Note
			Min	Max	Min	Max	Min	Max	Min	Max		
System clock cycle time	CAS Latency = 3	tCK3	8	-	10	-	10	-	10	-	ns	
	CAS Latency = 2	tCK2	10	-	10	-	12	-	10	-		
Clock high pulse width		tCHW	3	-	3	-	3	-	3	-	ns	1
Clock low pulse width		tCLW	3	-	3	-	3	-	3	-	ns	1
Access time from clock	CAS Latency = 3	tAC3	-	6	-	6	-	6	-	8	ns	
	CAS Latency = 2	tAC2	-	6	-	6	-	6	-	8		
Data-out hold time		tOH	2	-	3	-	3	-	3	-	ns	
Data-Input setup time		tDS	2	-	2	-	2	-	3	-	ns	1
Data-Input hold time		tDH	1	-	1	-	1	-	1	-	ns	1
Address setup time		tAS	2	-	2	-	2	-	3	-	ns	1
Address hold time		tAH	1	-	1	-	1	-	1	-	ns	1
CKE setup time		tCKS	2	-	2	-	2	-	3	-	ns	1
CKE hold time		tCKH	1	-	1	-	1	-	1	-	ns	1
Command setup time		tCS	2	-	2	-	2	-	3	-	ns	1
Command hold time		tCH	1	-	1	-	1	-	1	-	ns	1
CLK to data output in low Z-time		tOLZ	2	-	2	-	2	-	2	-	ns	
CLK to data output in high Z-time	CAS Latency = 3	tOHZ3	2	9	3	9	3	9	3	10	ns	
	CAS Latency = 2	tOHZ2	2	9	3	9	3	9	3	10		

Note :

1. Assume t_R / t_F (input rise and fall time) is 1ns.
2. Access times to be measured with input signals of 1V/ns edge rate, 0.8V to 2.0V

AC CHARACTERISTICS II

Parameter		Symbol	-8		-10P		-10S		-10		Unit	Note
			Min	Max	Min	Max	Min	Max	Min	Max		
RAS cycle time	Operation	t _{RC}	70	-	70	-	70	-	80	-	ns	
	Auto Refresh	t _{RRC}	70	-	70	-	70	-	80	-	ns	
RAS to CAS delay		t _{RCD}	20	-	20	-	20	-	24	-	ns	
RAS active time		t _{RAS}	50	10K	50	10K	50	10K	50	10K	ns	
RAS precharge time		t _{RP}	20	-	20	-	20	-	20	-	ns	
RAS to RAS bank active delay		t _{RRD}	20	-	20	-	20	-	20	-	ns	
CAS to CAS bank active delay		t _{CCD}	1	-	1	-	1	-	1	-	CLK	
Write command to data-in delay		t _{WTL}	0	-	0	-	0	-	0	-	CLK	
Data-in to precharge command		t _{DPL}	1	-	1	-	1	-	1	-	CLK	
Data-in to active command		t _{DAL}	4	-	4	-	4	-	4	-	CLK	
DQM to data-in Hi-Z		t _{DQZ}	2	-	2	-	2	-	2	-	CLK	
DQM to data mask		t _{DQM}	0	-	0	-	0	-	0	-	CLK	
MRS to new command		t _{MRD}	2	-	2	-	2	-	2	-	CLK	
Precharge to data output Hi-Z	CAS Latency = 3	t _{PROZ3}	3	-	3	-	3	-	3	-	CLK	
	CAS Latency = 2	t _{PROZ2}	2	-	2	-	2	-	2	-	CLK	
Power down exit time		t _{PDE}	1	-	1	-	1	-	1	-	CLK	
Self refresh exit time		t _{SRE}	1	-	1	-	1	-	1	-	CLK	1
Refresh Time		t _{REF}	64	-	64	-	64	-	64	-	ms	

Note :

1. A new command can be given t_{RRC} after self refresh exit.

DEVICE OPERATING OPTION TABLE

HY57V161610D-8

	CAS Latency	tRCD	tRAS	tRC	tRP	tAC	tOH
125MHz	3CLKs	3CLKs	6CLKs	9CLKs	3CLKs	6ns	2ns
100MHz	2CLKs	2CLKs	5CLKs	7CLKs	2CLKs	6ns	3ns
83MHz	2CLKs	2CLKs	4CLKs	6CLKs	2CLKs	6ns	3ns
66MHz	2CLKs	2CLKs	4CLKs	5CLKs	2CLKs	6ns	3ns

HY57V161610D-10P

	CAS Latency	tRCD	tRAS	tRC	tRP	tAC	tOH
100MHz	2CLKs	2CLKs	5CLKs	7CLKs	2CLKs	6ns	3ns
83MHz	2CLKs	2CLKs	5CLKs	6CLKs	2CLKs	6ns	3ns
66MHz	2CLKs	2CLKs	4CLKs	5CLKs	2CLKs	6ns	3ns
50MHz	2CLKs	1CLK	3CLKs	4CLKs	1CLK	6ns	3ns

HY57V161610D-10S

	CAS Latency	tRCD	tRAS	tRC	tRP	tAC	tOH
100MHz	3CLKs	2CLKs	5CLKs	7CLKs	2CLKs	6ns	3ns
83MHz	2CLKs	2CLKs	5CLKs	6CLKs	2CLKs	6ns	3ns
66MHz	2CLKs	2CLKs	4CLKs	5CLKs	2CLKs	6ns	3ns
50MHz	2CLKs	1CLK	3CLKs	4CLKs	1CLK	6ns	3ns

HY57V161610D-10

	CAS Latency	tRCD	tRAS	tRC	tRP	tAC	tOH
100MHz	3CLKs	3CLKs	5CLKs	8CLKs	2CLKs	8ns	3ns
83MHz	2CLKs	2CLKs	5CLKs	7CLKs	2CLKs	8ns	3ns
66MHz	2CLKs	2CLKs	4CLKs	6CLKs	2CLKs	8ns	3ns
50MHz	2CLKs	2CLKs	3CLKs	4CLKs	1CLK	8ns	3ns

COMMAND TRUTH TABLE

Command	CKEn-1	CKEn	CS	RAS	CAS	WE	DQM	Ad-A9	A10/AP	BA	Note	
Mode Register Set	H	X	L	L	L	L	X	OP code				
No Operation	H	X	H	X	X	X	X	X				
			L	H	H	H						
Bank Active	H	X	L	L	H	H	X	Row Address		V		
Read	H	X	L	H	L	H	X	Column Address	L	V		
Read with Auto precharge									H			
Write	H	X	L	H	L	L	X	Column Address	L	V		
Write with Auto precharge									H			
Precharge All Bank	H	X	L	L	H	L	X	X	H	X		
Precharge selected Bank									L	V		
Burst Stop	H	X	L	H	H	L	X	X				
U/LDQM	H	X					V	X				
Auto Refresh	H	H	L	L	L	H	X	X				
Self Refresh ¹	Entry	H	L	L	L	L	H	X	X			
	Exit	L	H	H	X	X	X					X
Entry				H	L	H	X	X	X	X	X	
	Exit	L	H			L	H	H	H			
Entry				H	L	H	X	X	X	X	X	
	Exit	L	H			L	V	V	V			
Exit				L	H	X				X		

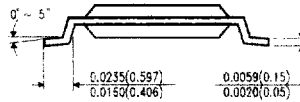
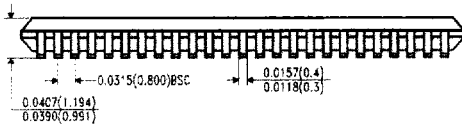
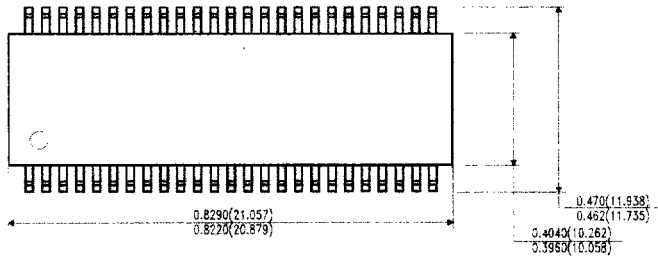
Note :

1. Exiting Self Refresh occurs by asynchronously bringing CKE from low to high.
2. X=Do not care, L=Low, H=High, BA=Bank Address, RA= Row Address, CA=Column Address, Opcode=Operand Code, NOP=No Operation.

PACKAGE INFORMATION

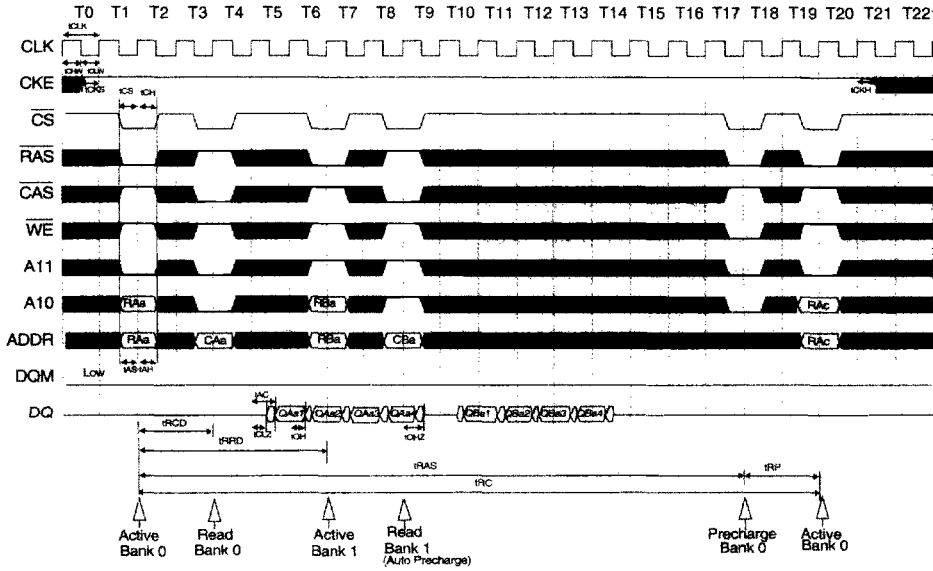
**400mil 50pin Thin Small Outline Package (TC)
1Mx16 Synchronous DRAM**

UNIT : INCH (mm)

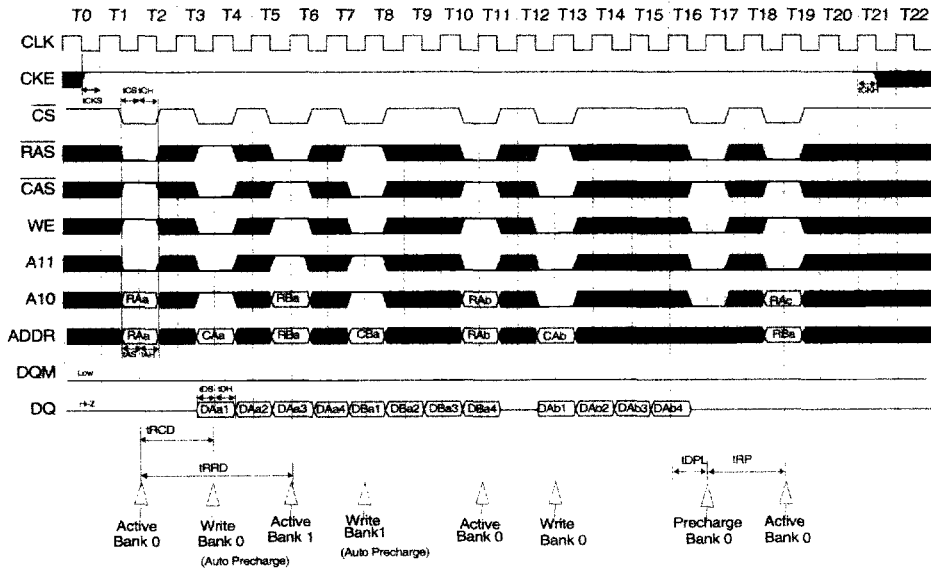


1. AC Parameters for READ Timing
2. AC Parameters for WRITE Timing
3. Mode Register Set Cycle
4. Power on Sequence and Auto Refresh
5. \overline{CS} Function (Only \overline{CS} Signal needs to be asserted at minimum at minimum rate)
6. CKE Timing for Power Down Mode
7. Self-Refresh Entry and Exit
8. CKE Timing for Clock Suspend during Burst READ (BL=4, CL=2)
9. CKE Timing for Clock Suspend during Burst READ (BL=4, CL=3)
10. CKE Timing for Clock Suspend during Burst WRITE (BL=4)
11. Random Column Read (Page with same bank, BL=4, CL=2)
12. Random Column Read (Page with same bank, BL=4, CL=3)
13. Random Column Write (Page with same bank, BL=4, CL=2)
14. Random Column Write (Page with same bank, BL=4, CL=3)
15. Random Row Read (Pingpong banks, BL=8, CL=2)
16. Random Row Read (Pinpong banks, BL=8, CL=3)
17. Random Row Write (Pinpong banks, BL=8, CL=2)
18. Random Row Write (Pinpong banks, BL=8, CL=3)
19. Read and Write DQM Function (BL=4, CL=2)
20. Read and Write DQM Function (BL=4, CL=3)
21. Interleaved Column Read Cycle (BL=4, CL=2)
22. Interleaved Column Read Cycle (BL=4, CL=3)
23. Interleaved Column Write Cycle (BL=4, CL=2)
24. Interleaved Column Write Cycle (BL=4, CL=3)
25. Full Page Read Cycle (CL=2)
26. Full Page Write Cycle (CL=2)
27. Auto Precharge after READ Burst (BL=4, CL=2)
28. Auto Precharge after WRITE Burst (BL=4, CL=2)
29. Test Mode for Read Cycle (BL=4, CL=2)
30. Test Mode for Write Cycle (BL=4, CL=2)

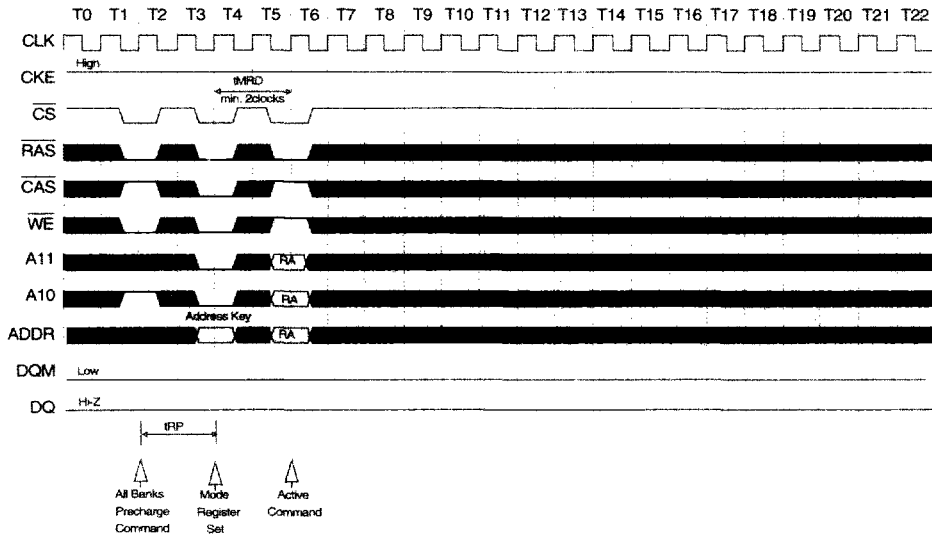
1. AC Parameters for READ Timing : BL=4, CL=2



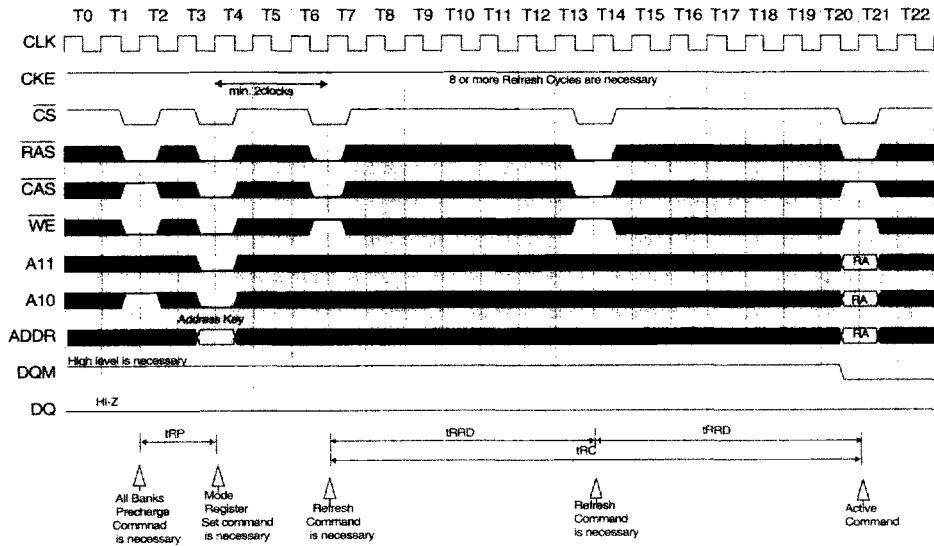
2. AC Parameters for WRITE Timing : BL=4, CL=2



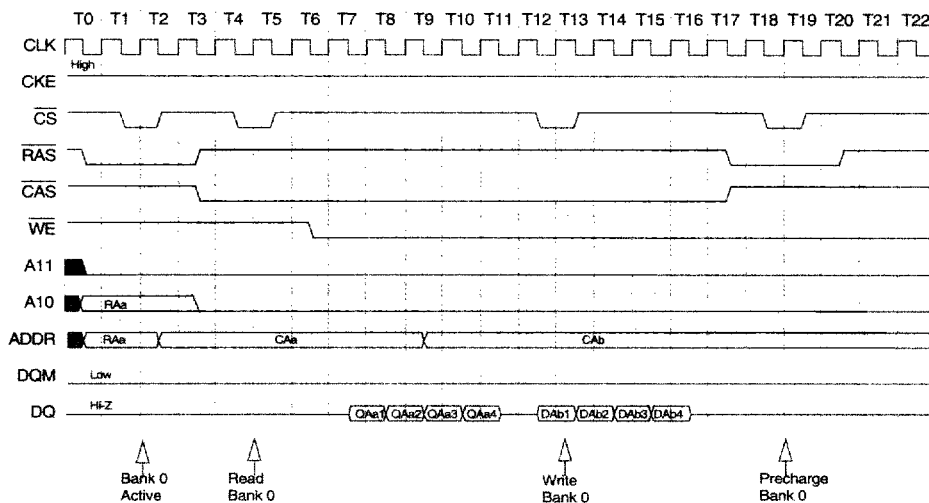
3. Mode Register Set Cycle



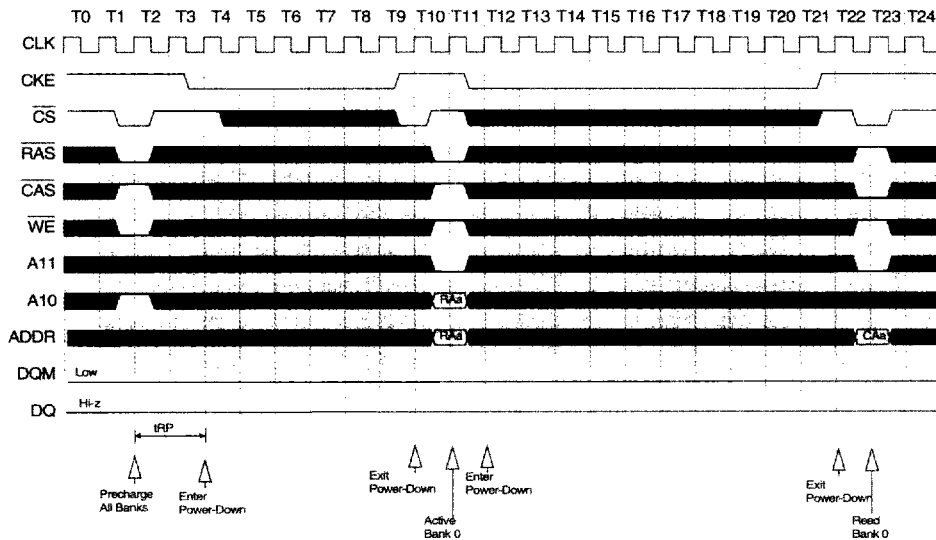
4. Power on Sequence and Auto Refresh



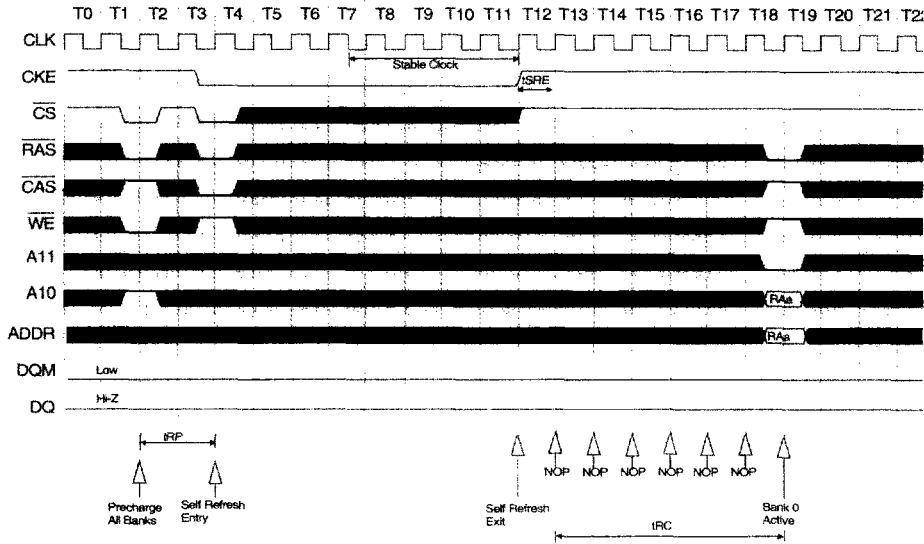
5. $\overline{\text{CS}}$ Function (Only $\overline{\text{CS}}$ signal needs to be asserted at min, rate) : BL=4, CL=3



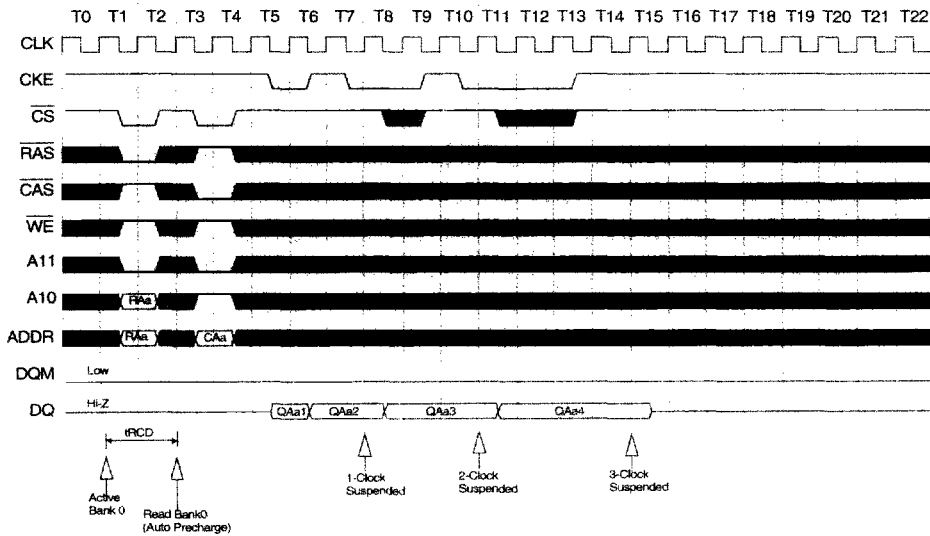
6. CKE Timing for Power Down Mode



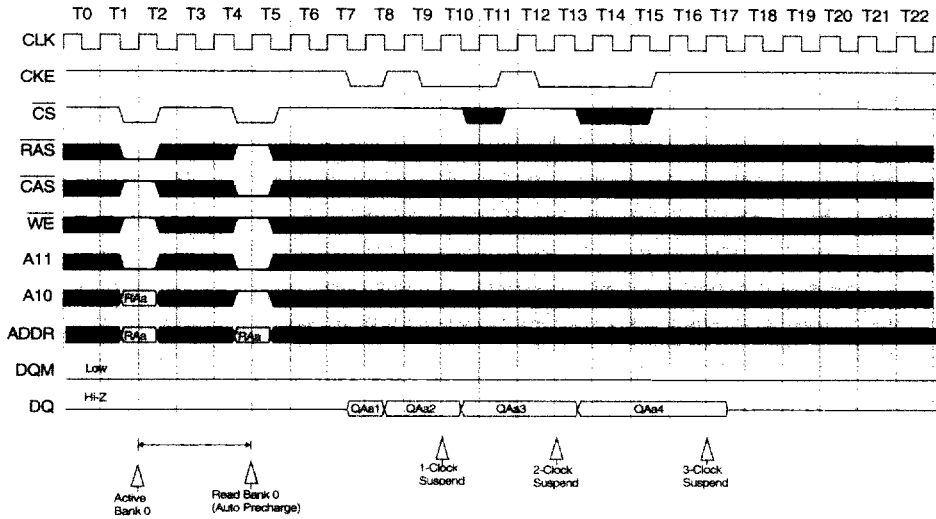
7. Self Refresh Entry and Exit



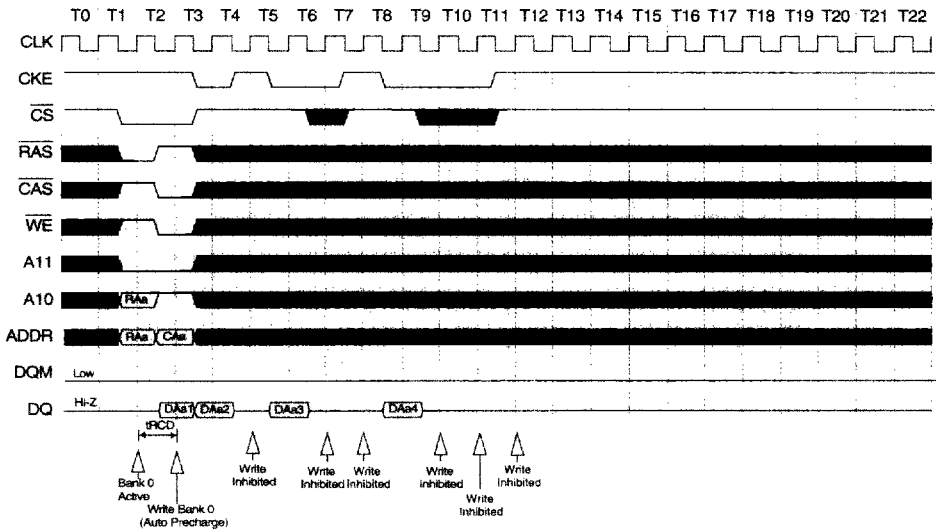
8. CKE Timing for Clock Suspend during Burst READ : BL=4, CL=2



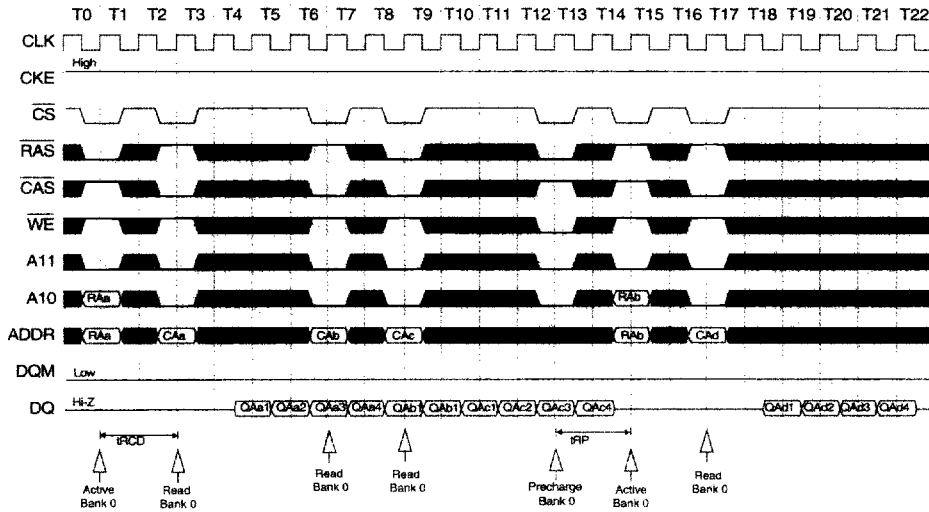
9. CKE Timing for Clock Suspend during Burst READ : BL=4, CL=3



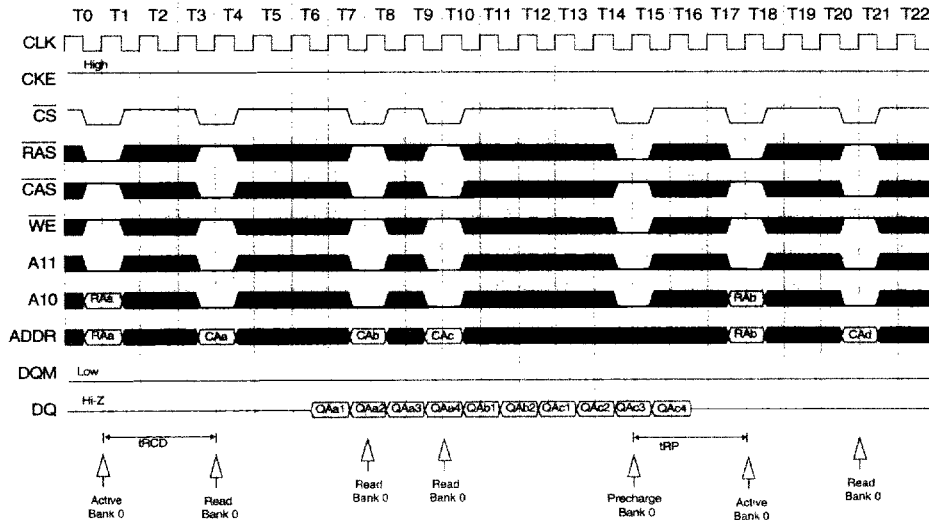
10. CKE Timing for Clock Suspend during Burst WRITE : BL=4



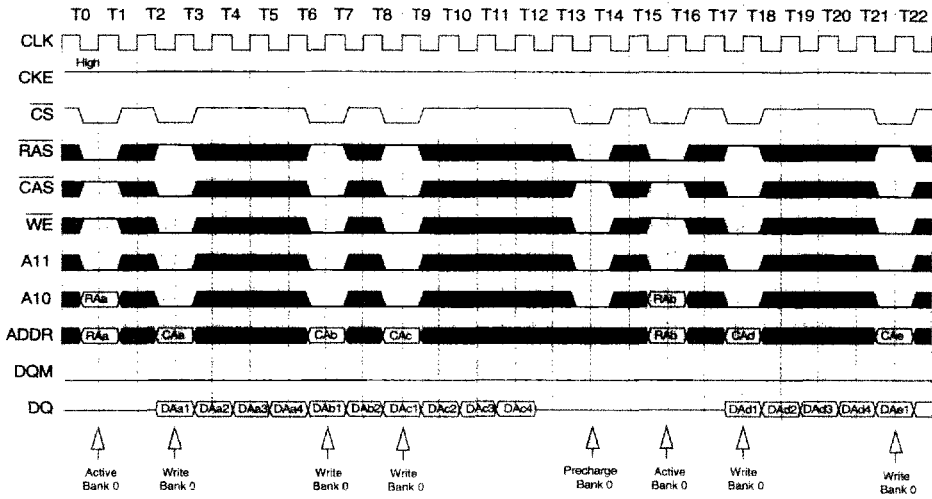
11. Random Column Read (Page with same bank) : BL=4, CL=2



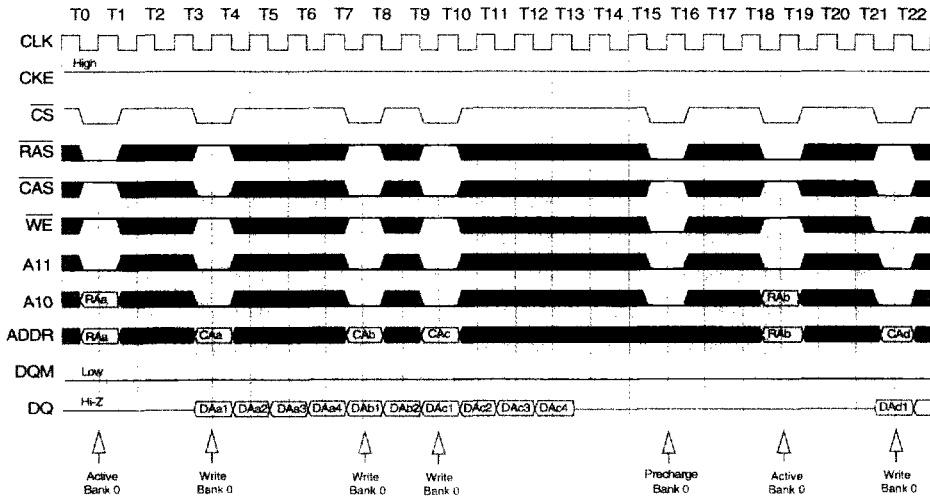
12. Random Column Read (Page with same bank) : BL=4, CL=3



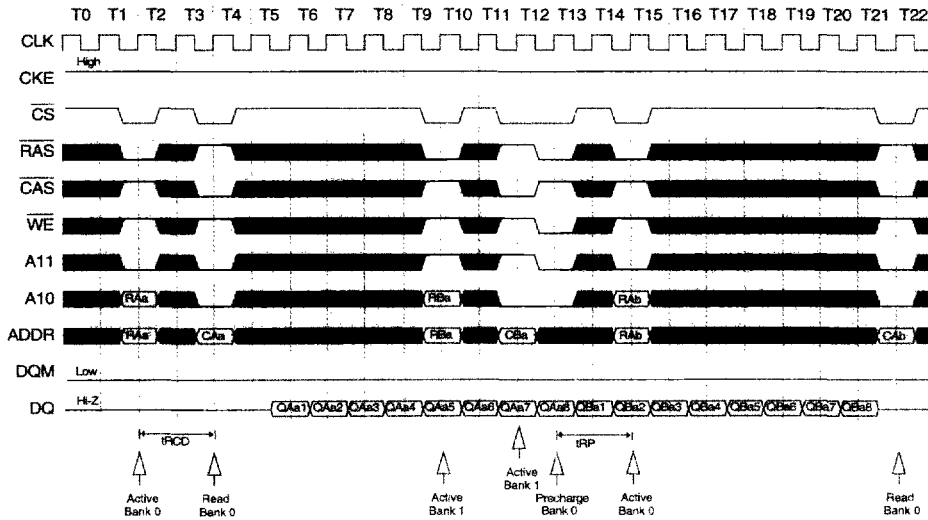
13. Random Column Write (Page with same bank) : BL=4, CL=2



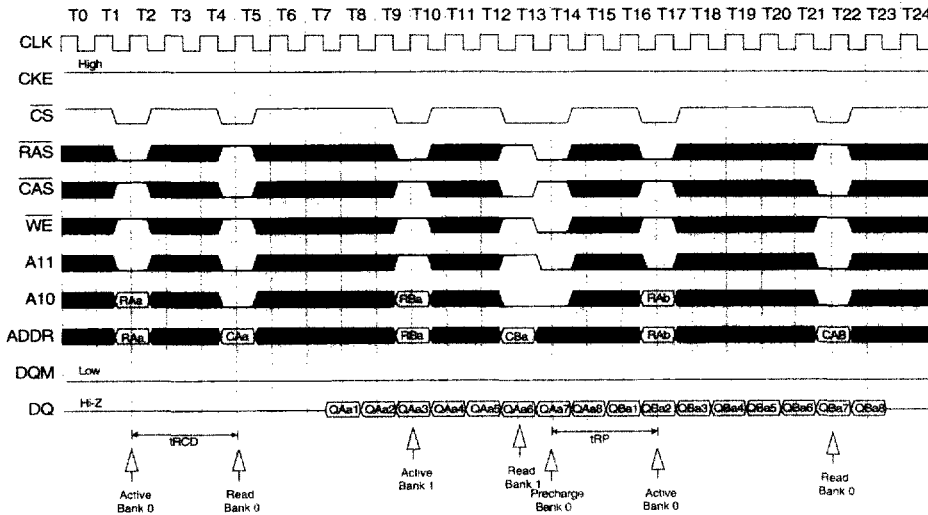
14. Random Column Write (Page with same bank) : BL=4, CL=3



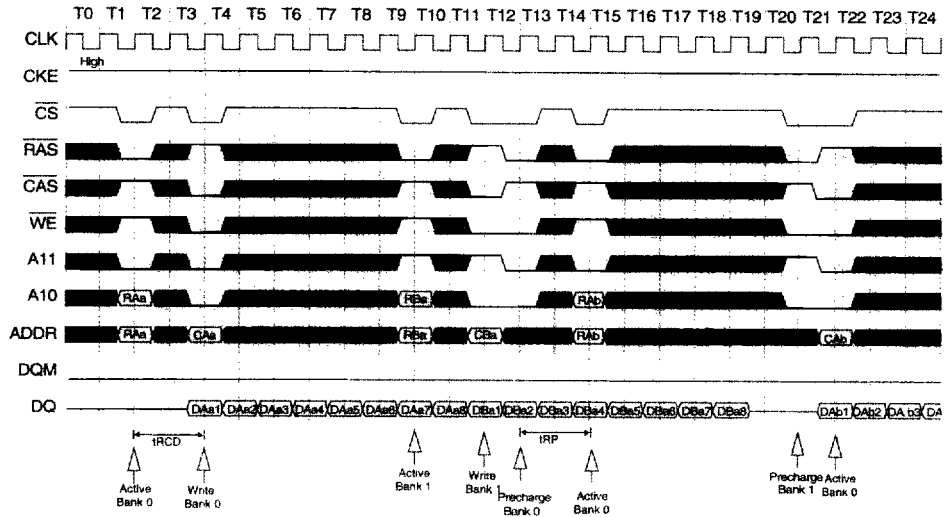
15. Random Row Read (Pingpong banks) : BL=8, CL=2



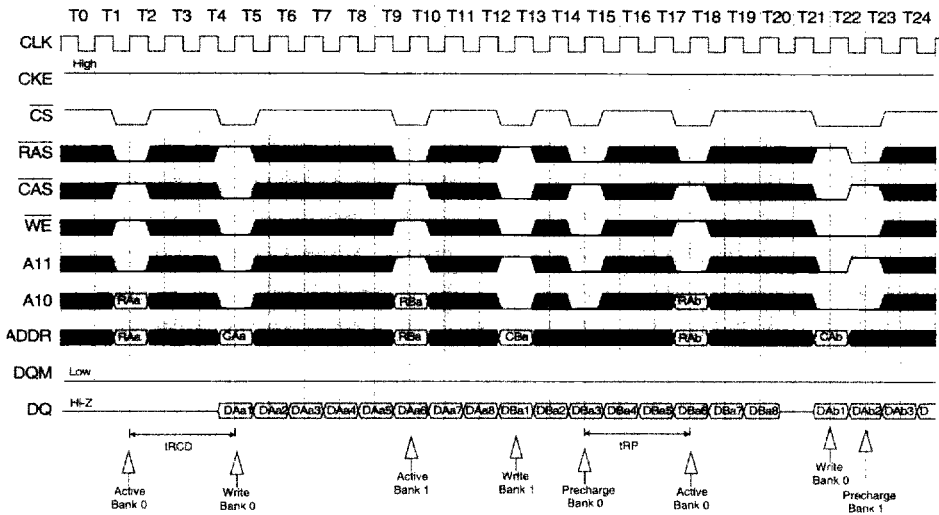
16. Random Row Read (Pingpong banks) : BL=8, CL=3



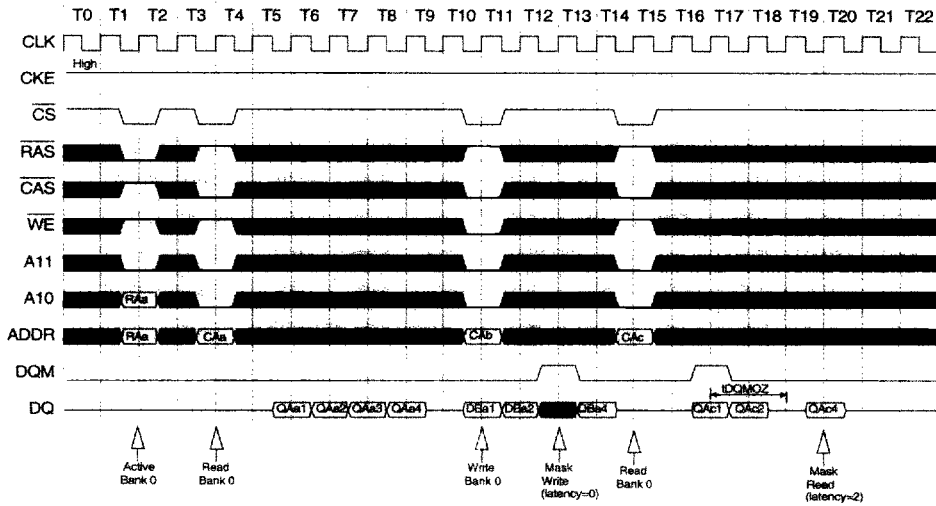
17. Random Row Write (Pingpong banks) : BL=8, CL=2



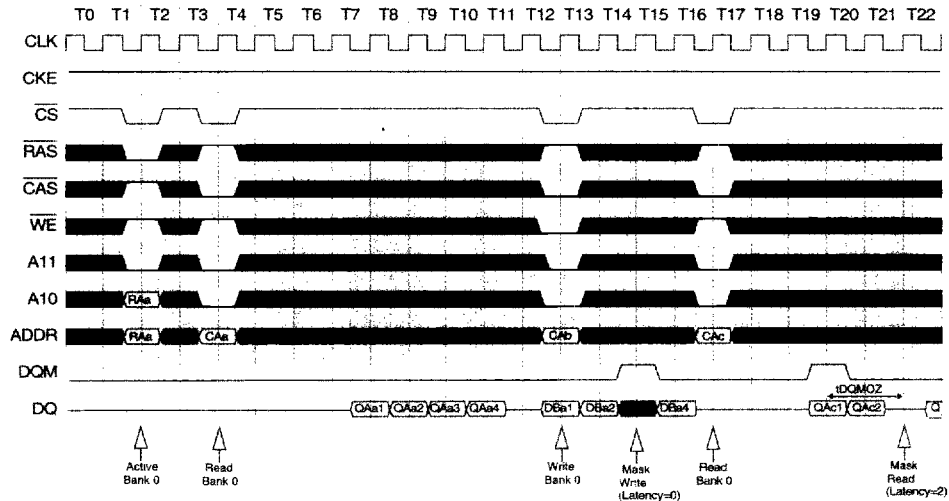
18. Random Row Write (Pingpong banks) : BL=8, CL=3



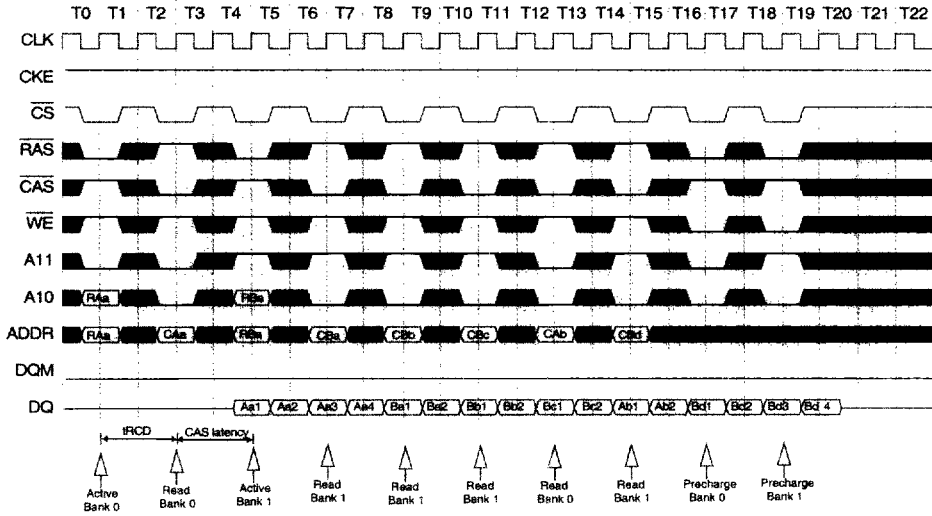
19. Read and Write with DQM Function : BL=4, CL=2



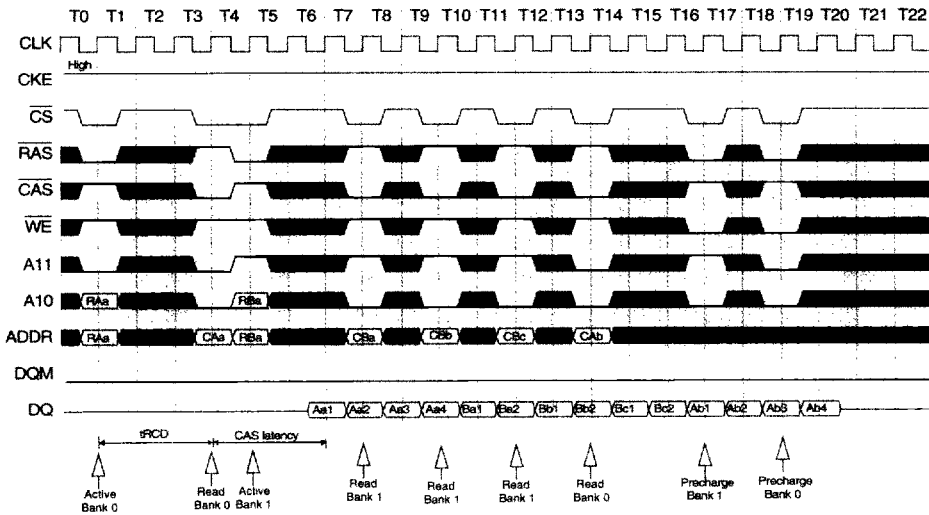
20. Read and Write with DQM Function : BL=4, CL=3



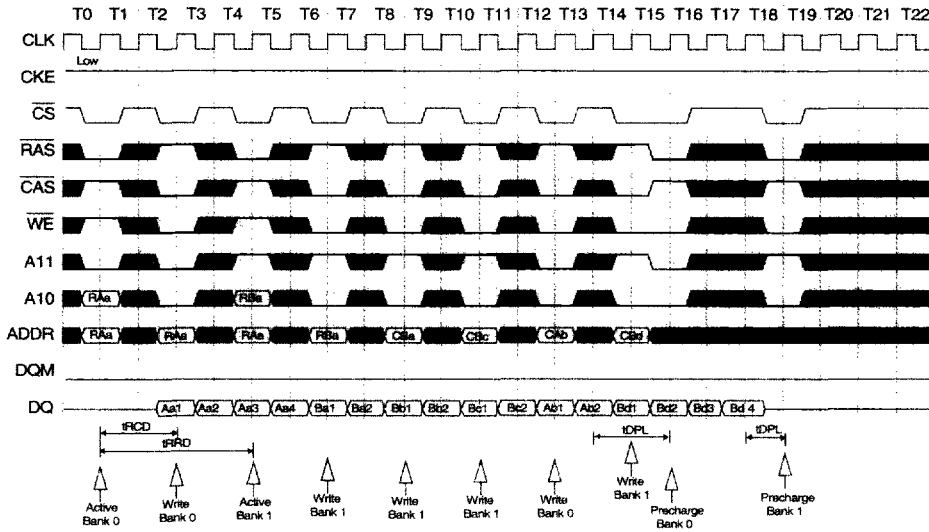
21. Interleaved Column Read Cycle : BL=4, CL=2



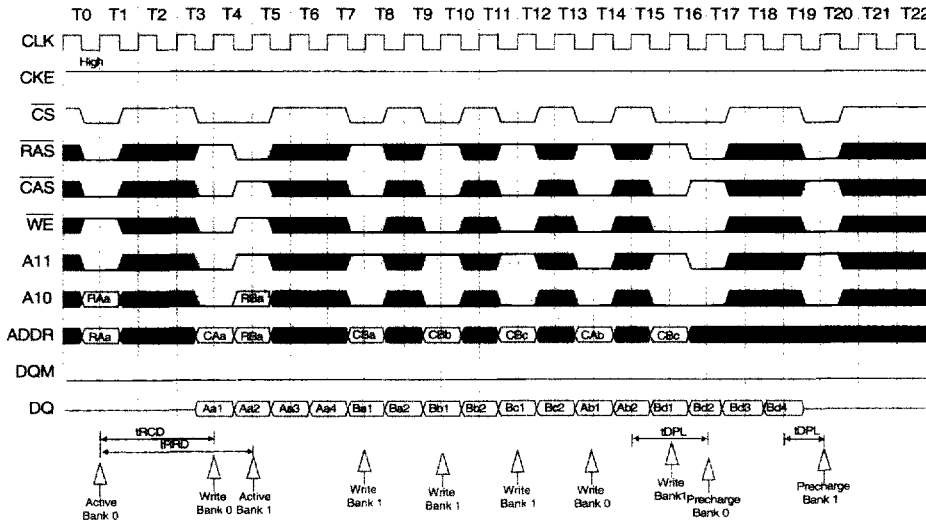
22. Interleaved Column Read Cycle : BL=4, CL=3



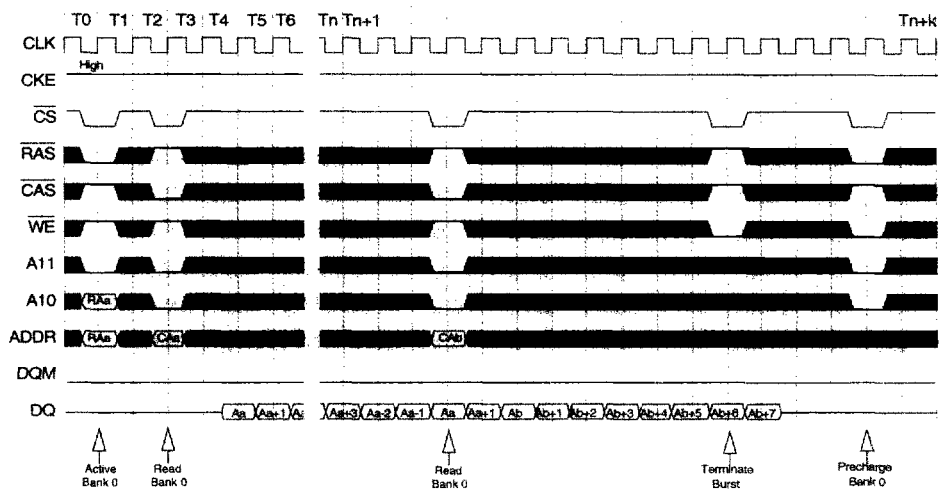
23. Interleaved Column Write Cycle : BL=4, CL=2



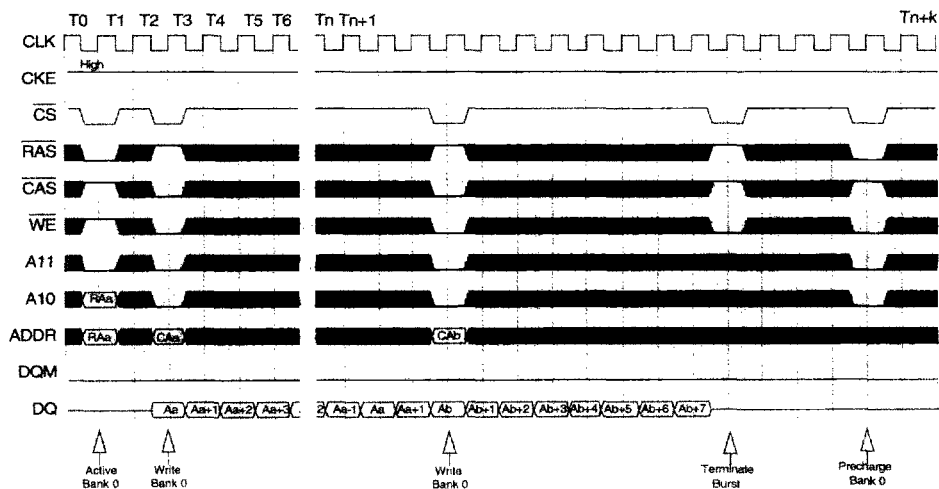
24. Interleaved Column Write Cycle : BL=4, CL=3



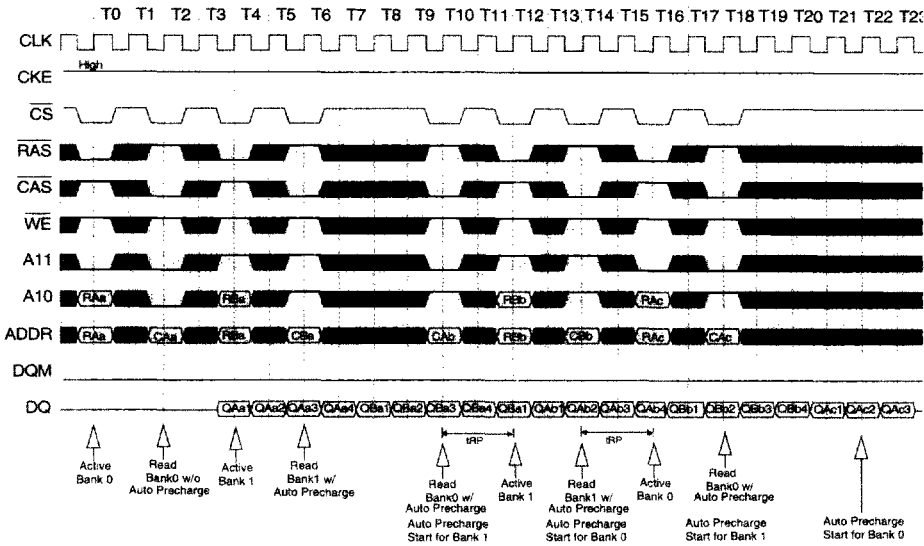
25. Full Page Read Cycle : CL=2



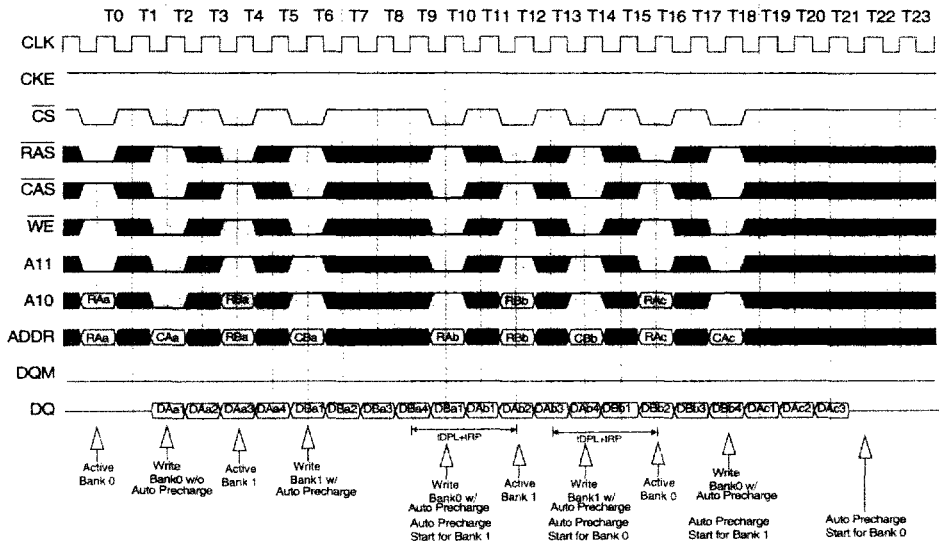
26. Full Page Write Cycle : CL=2



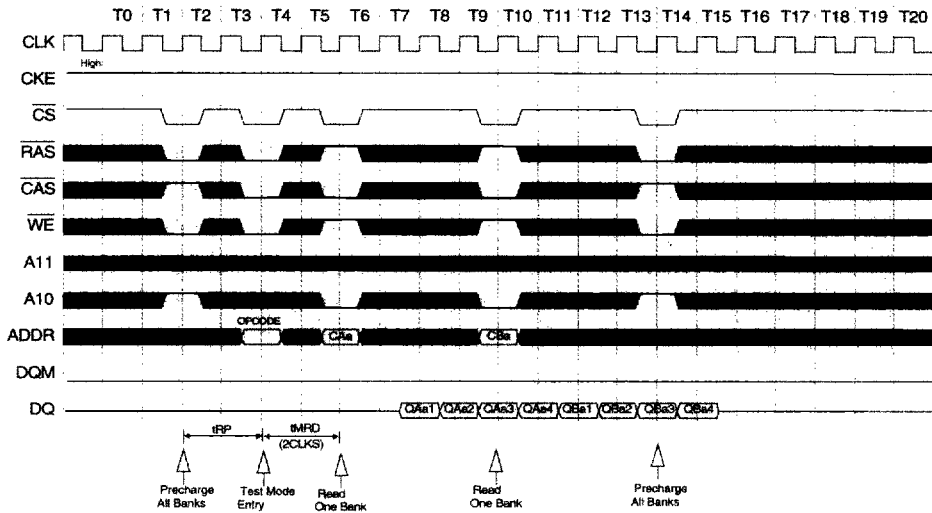
27. Auto Precharge after Read Burst : BL=4, CL=2



28. Auto Precharge after Write Burst : BL=4, CL=2



29. Test Mode for Read Cycle : BL=4, CL=2



30. Test Mode for Write Cycle : BL=4, CL=2

