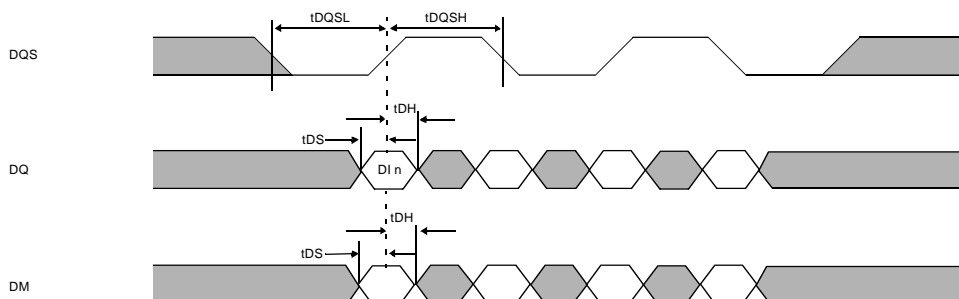


Timing Diagram

1. Data Input (Write) Timing
2. Data Output (Read) Timing
3. Power Down Mode
4. Auto Refresh Mode
5. Self Refresh Mode
6. Read without Auto Precharge
7. Read with Auto Precharge
8. Bank Read Access
9. Write without Auto Precharge
10. Write with Auto Precharge
11. Bank Write Access
12. Write DM Operation

Data Input (Write) Timing (BL=4)

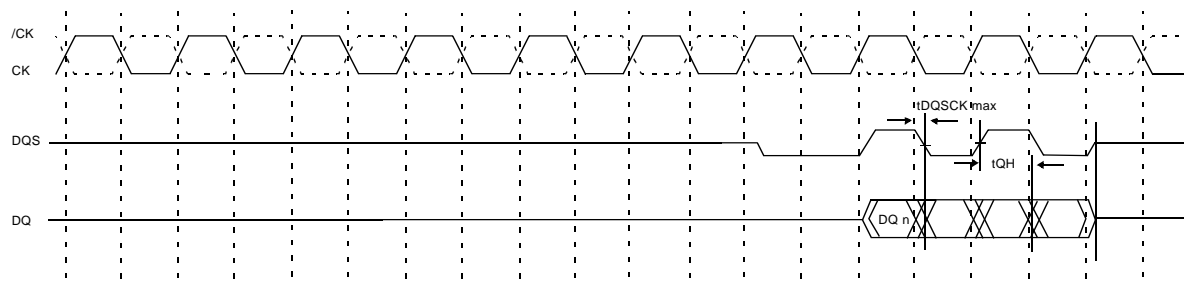


DI n = Data in for column n

3 subsequent elements of data in are applied in the programmed order following DI n

Don't care

Data Output (Read) Timing (BL=4)



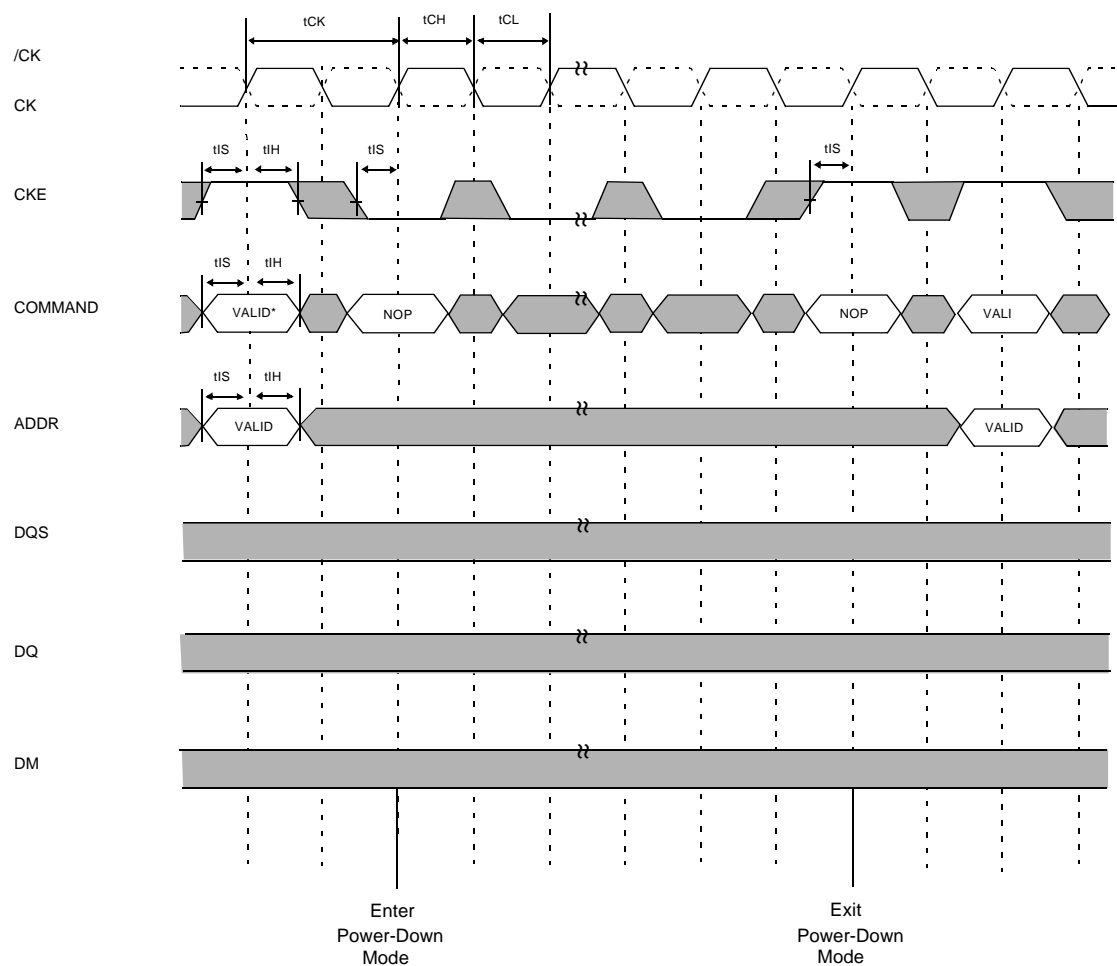
t_{DQSQ} and t_{QH} are only shown once, and are shown referenced to different edges of DQS, only for clarity of illustration. t_{DQSQ} and t_{QH} both apply to each of the four relevant edges of DQS.

$t_{QHmin} = t_{HPmin} - X$ where ;

t_{HP} = minimum half clock period for any given cycle and is defined by clock high or clock low (t_{CH} , t_{CL})

X consists of $t_{DQSQmax}$, the pulse width distortion of on-chip clock circuits, data pin to pin skew and output pattern effects, and p-channel to n-channel variation of the output drivers.

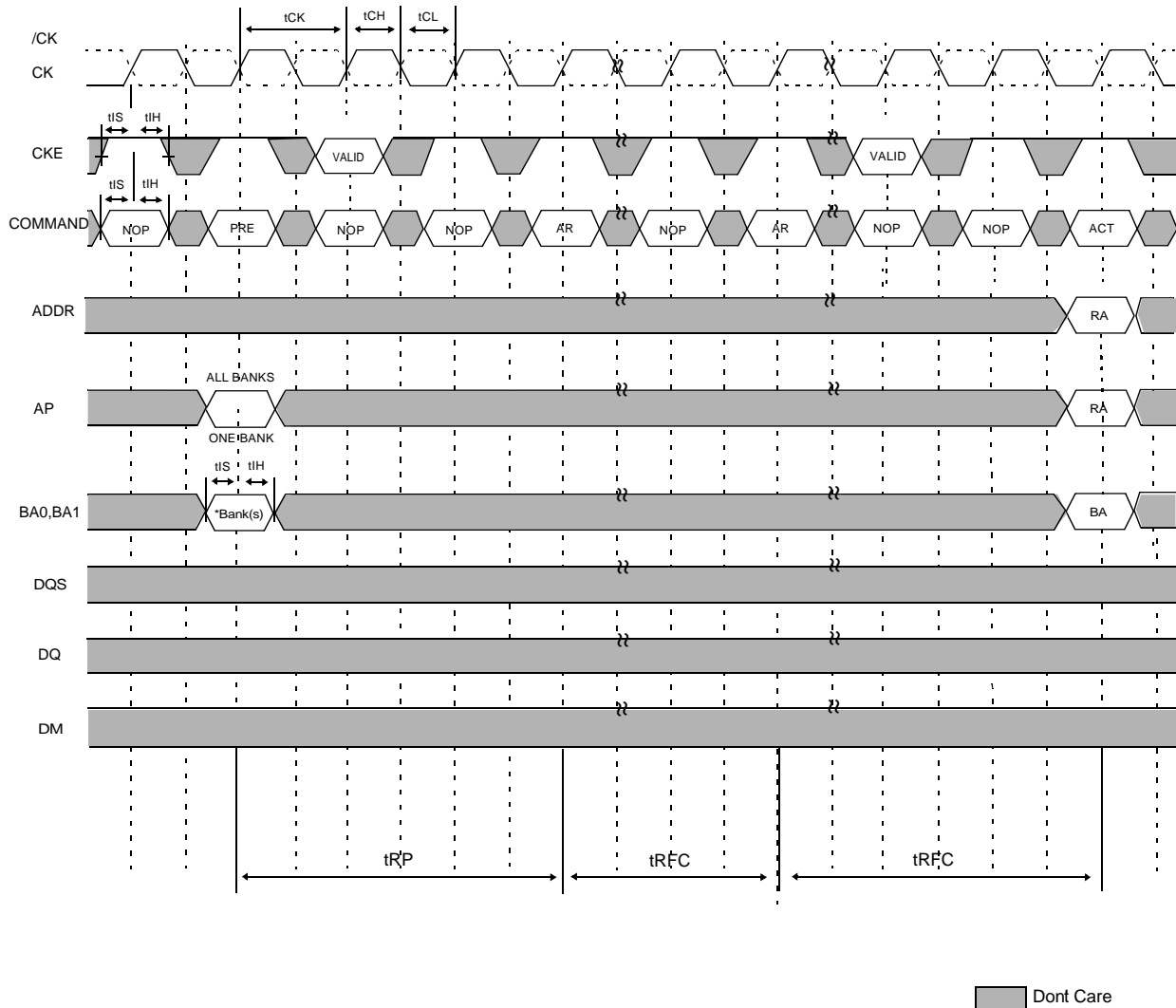
Power Down Mode



Don't Care

No column accesses are allowed to be in progress at the time Power-Down is entered.
 * = If this command is a PRECHARGE (or if the device is already in the idle state) then the Power-Down mode shown is Precharge Power Down. If this command is an ACTIVE (or if at least one row is already active) then the Power-Down mode shown is Active Power Down.

Auto Refresh Mode



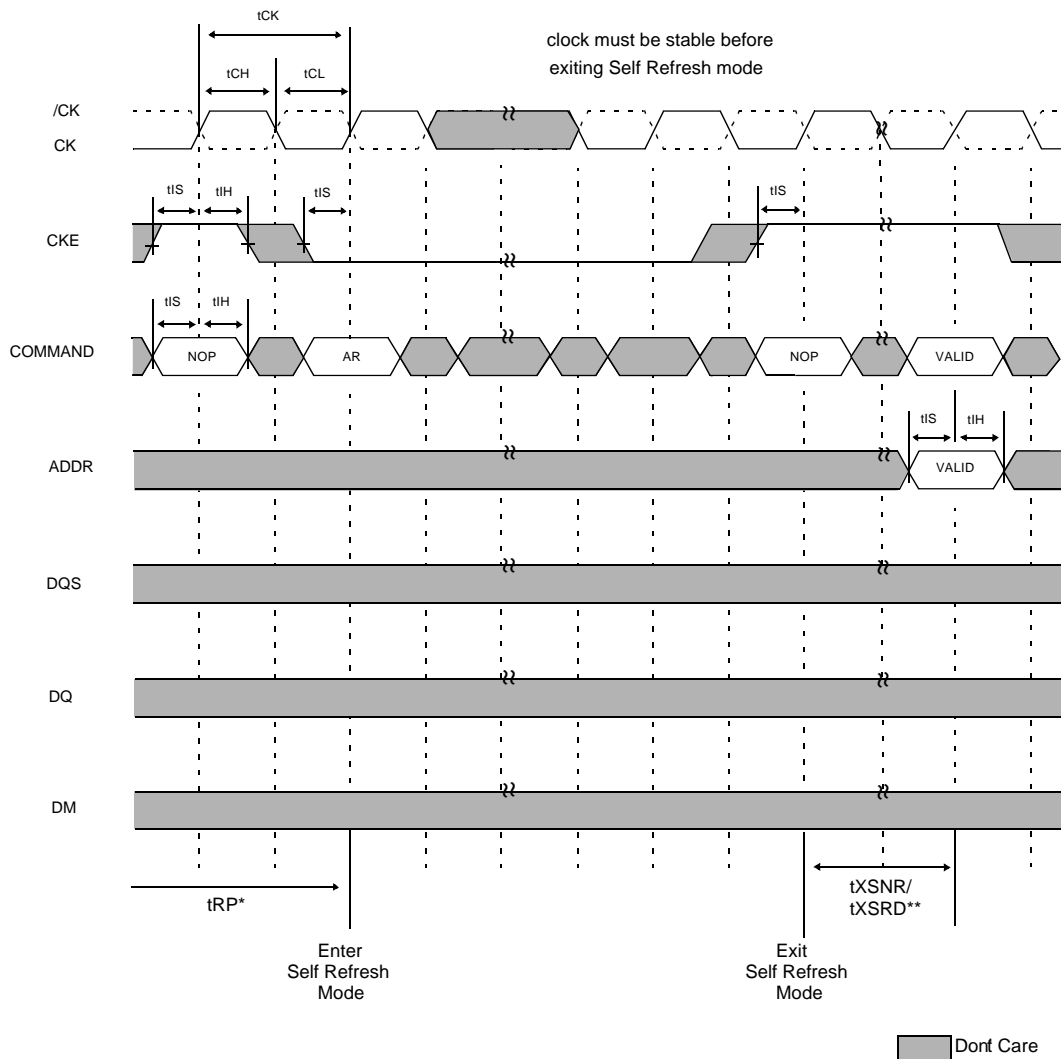
* = "Dont Care", if AP is High at this point ; AP must be High if more than one bank is active (i.e., must precharge all active banks)

PRE = Precharge, ACT = Active, RA = Row Address, BA = Bank Address, AR = Autorefresh.

NOP commands are shown for ease of illustration ; other valid commands may be possible at these times.

DM, DQ and DQS signals are all "Dont Care"/ High-Z for operation shown.

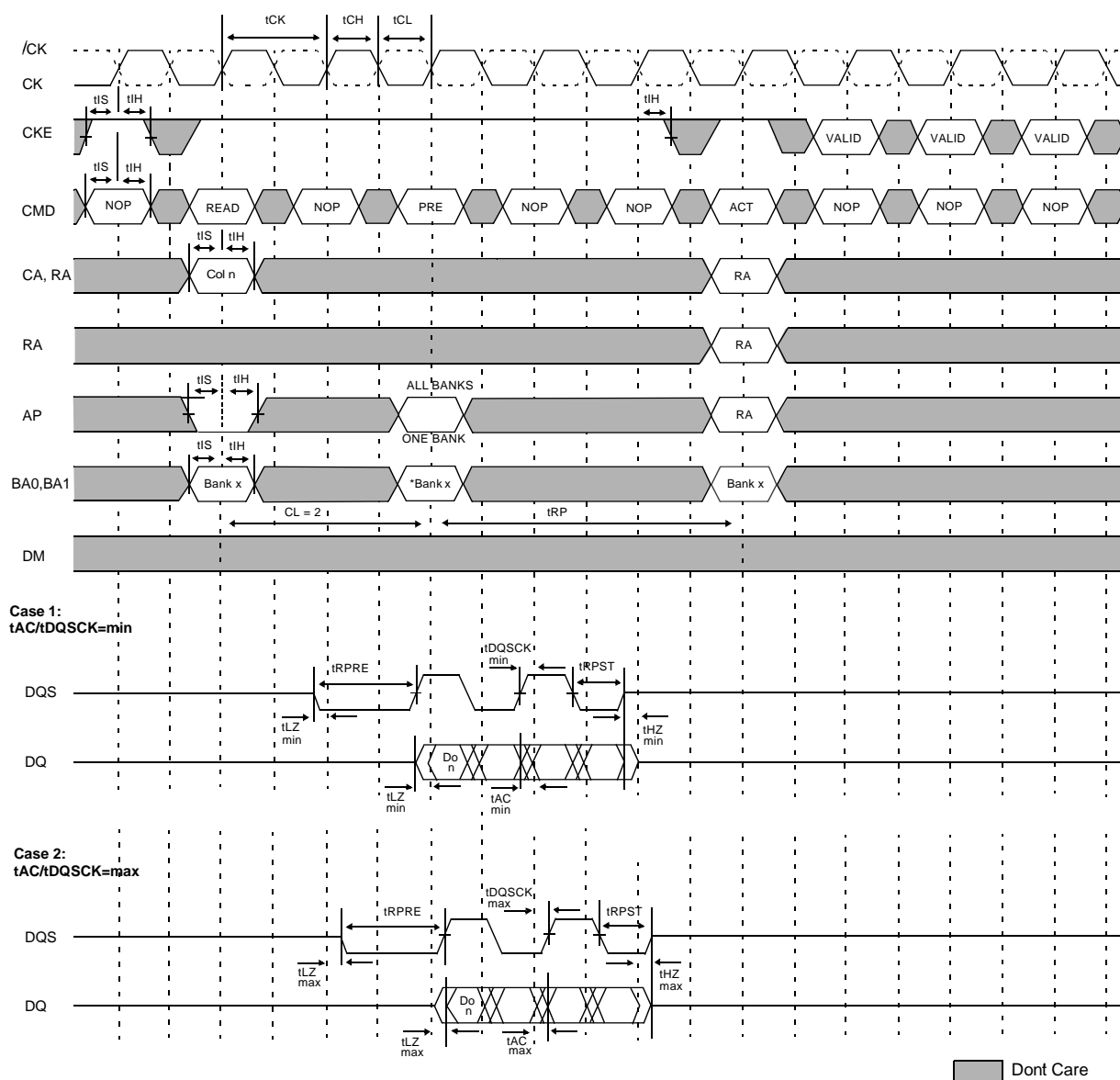
Self Refresh Mode



* = Device must be in the "All banks idle" state prior to entering Self Refresh mode

** = t_{XSNR} is required before any non-READ command can be applied, and t_{XSRD} (200 cycles of CK) are required before a READ command can be applied.

Read Without Auto Precharge



DO n = Data Out from column n

Burst Length = 4 in the case shown

3 subsequent elements of Data Out are provided in the programmed order following DO n

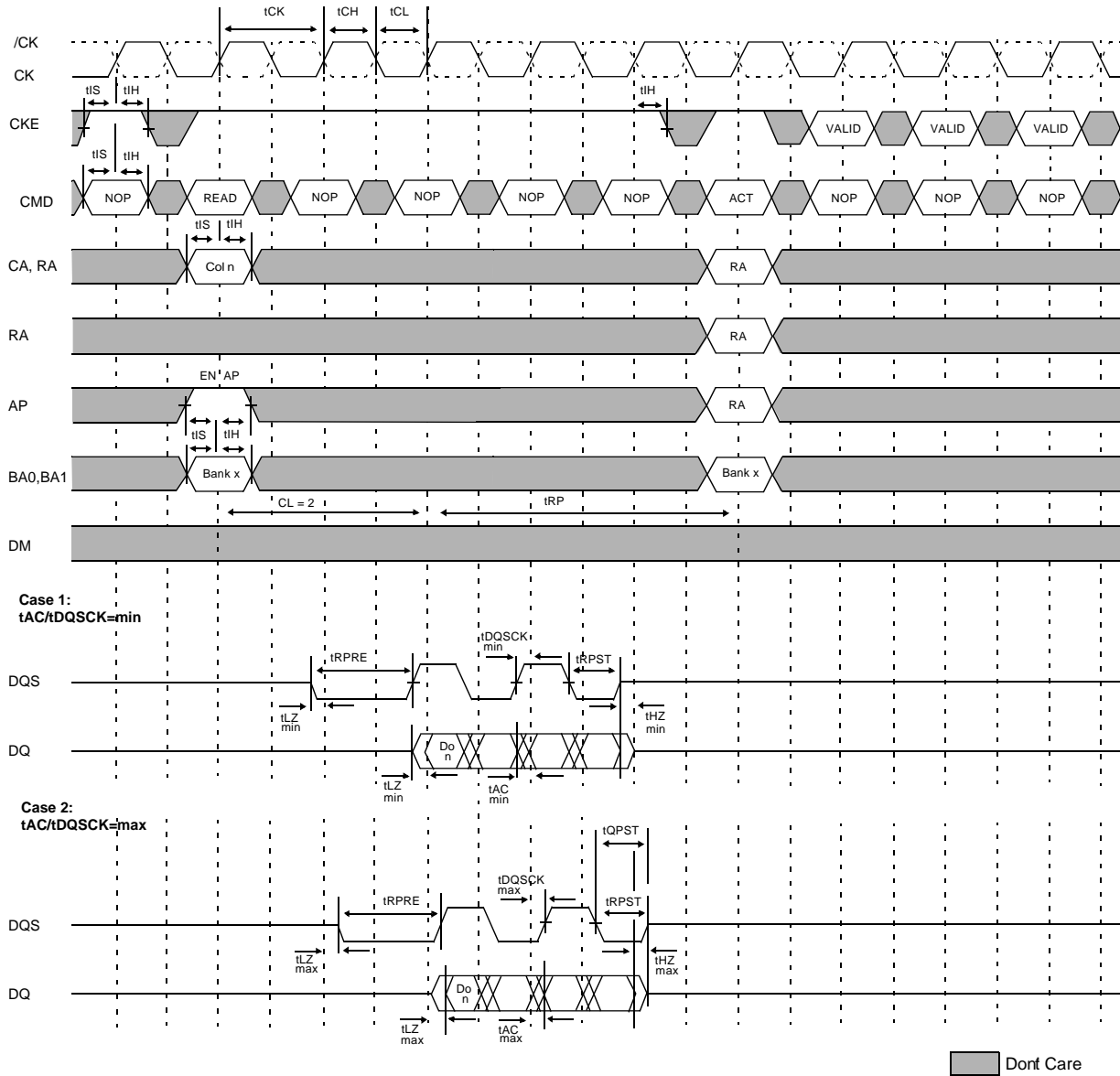
DIS AP = Disable Autoprecharge

* = 'Dont Care', if AP is HIGH at this point

PRE = PRECHARGE, ACT = ACTIVE, RA = Row Address, BA = Bank Address

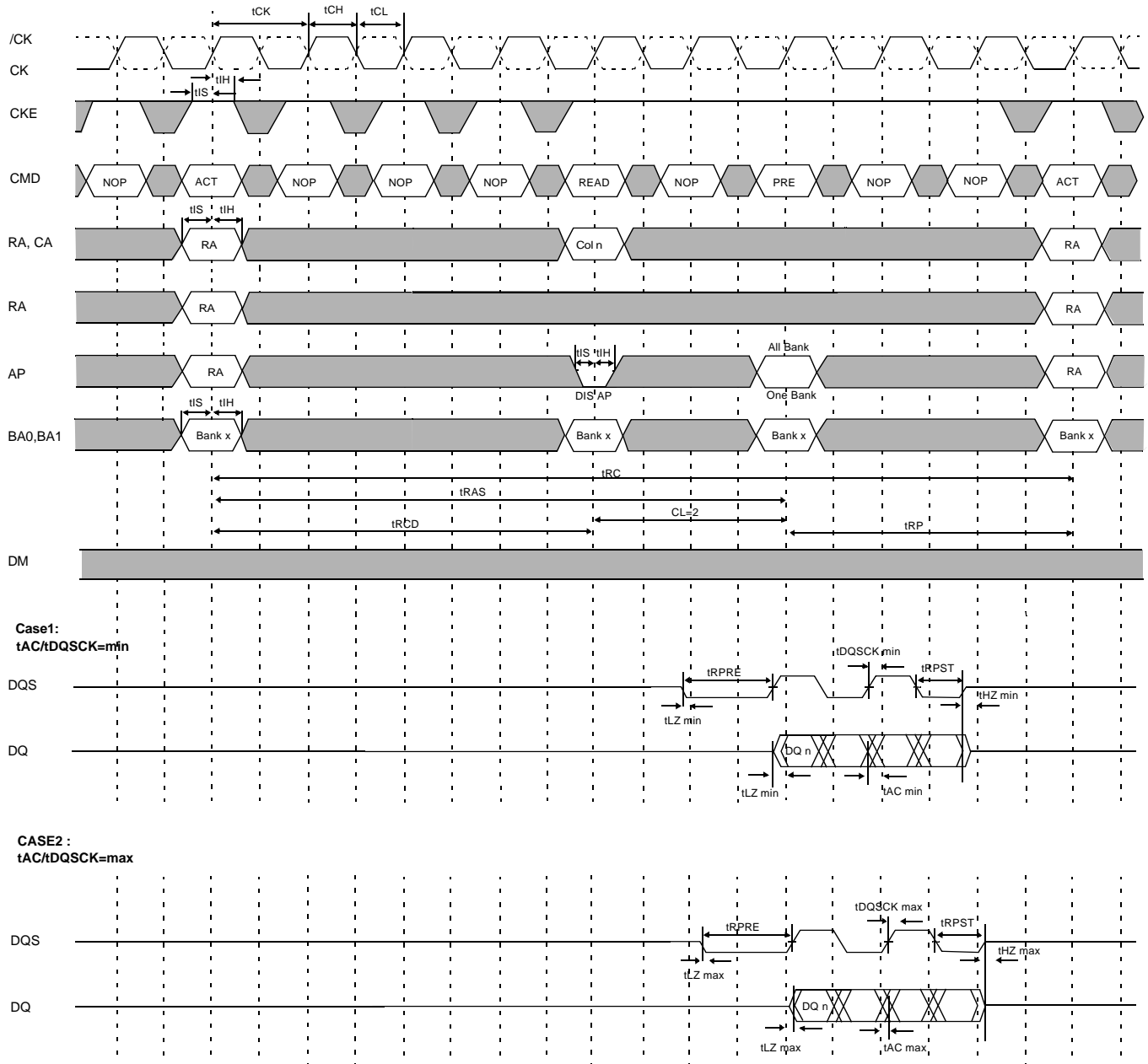
NOP commands are shown for ease of illustration ; other commands may be valid at these times

Read With Auto Precharge



DO n = Data Out from column n
 Burst Length = 4 in the case shown
 3 subsequent elements of Data Out are provided in the programmed order following DO n
 EN AP = Enable Autoprecharge, ACT = ACTIVE, RA = Row Address
 NOP commands are shown for ease of illustration ; other commands may be valid at these times

Bank Read Access



DQ n = Data out from column n
 Burst length = 4 in the case shown
 3 subsequent elements of Data out are provided in the programmed order following DQ n
 DIS AP = Disable Autoprecharge

* = "Dont Care", if AP is high at this point

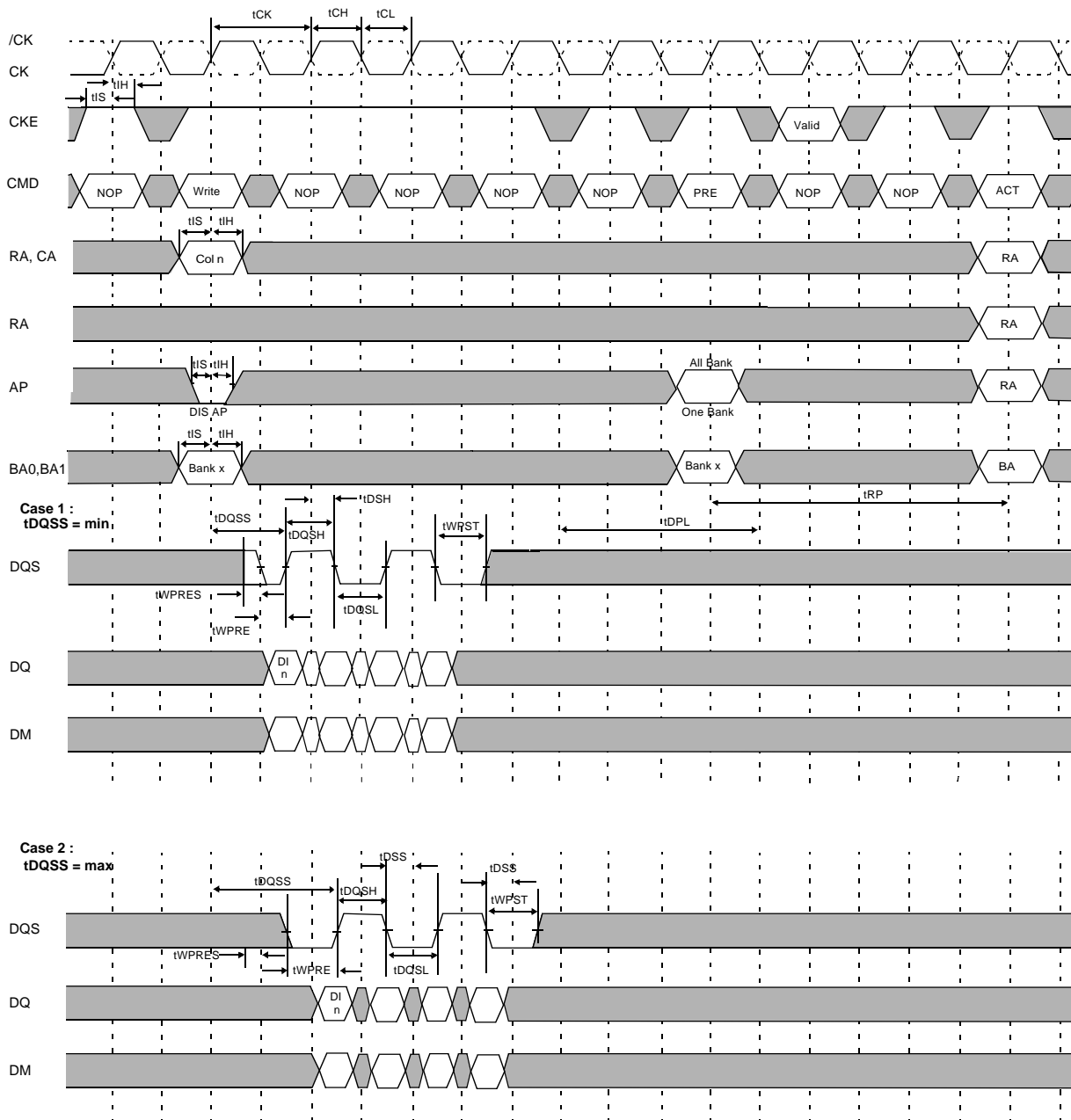
PRE = Precharge, ACT=Active, RA=Row Address, BA=Bank Address

NOP commands are shown for ease of illustration; other commands may be valid at these times

Note that $t_{RCD} > t_{RCD\ min}$ so that the same timing applies if Autoprecharge is enabled (in which case t_{RAS} would be limiting)

Dont care

Write Without Auto Precharge



DI n = Data in for column n

Burst length = 4 in the case shown

3 subsequent elements of Data In are provided in the programmed order following DI n

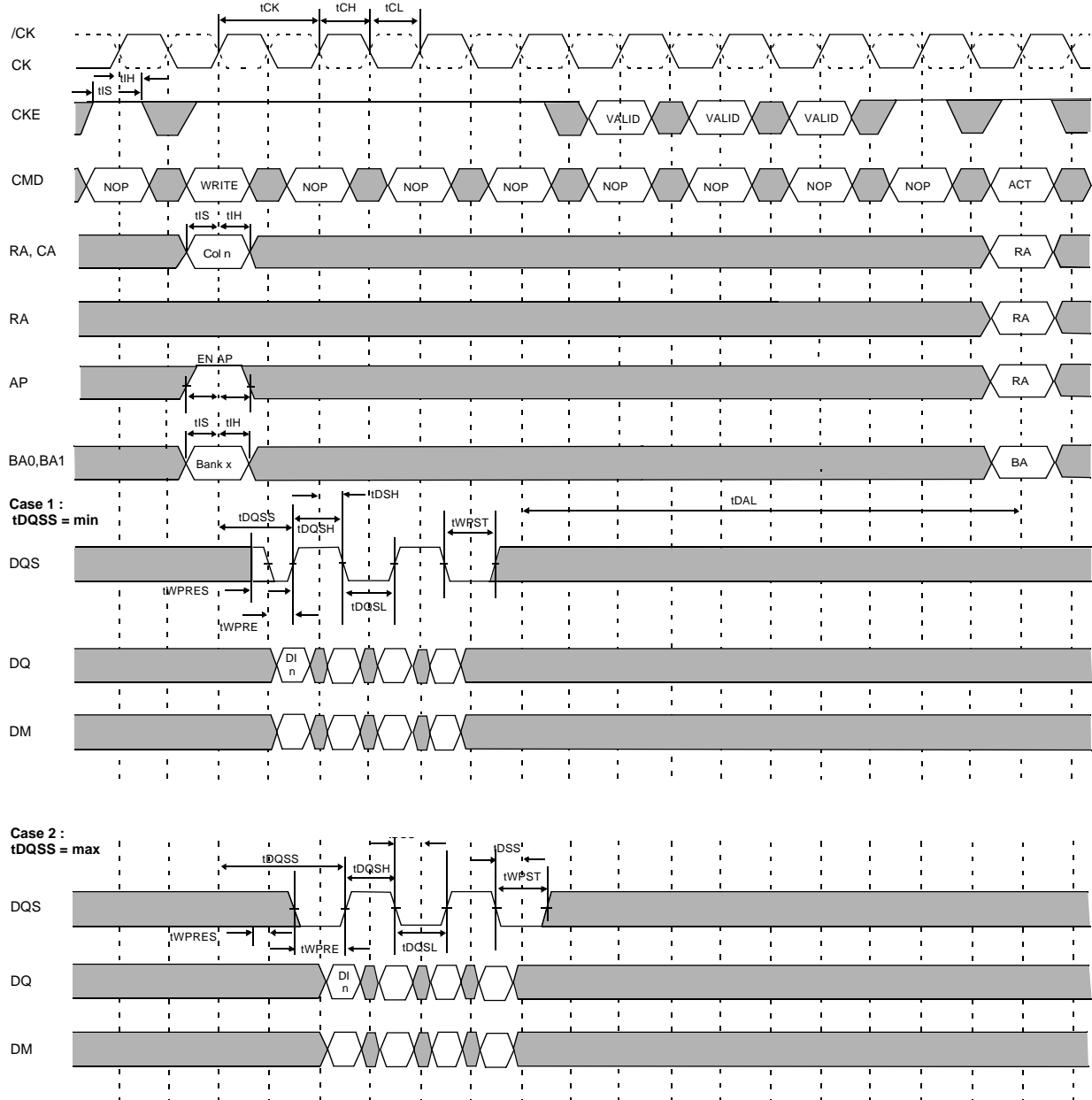
DIS AP = Disable Autoprecharge

* = "Dont Care", if AP is high at this point

PRE = Precharge, ACT=Active, RA=Row Address, BA=Bank Address

NOP commands are shown for ease of illustration; other valid commands may be possible at these times

Write With Auto Precharge



DI n = Data in for column n

Burst length = 4 in the case shown


3 subsequent elements of Data In are applied in the programmed order following Data In

EN AP = Enable Autoprecharge

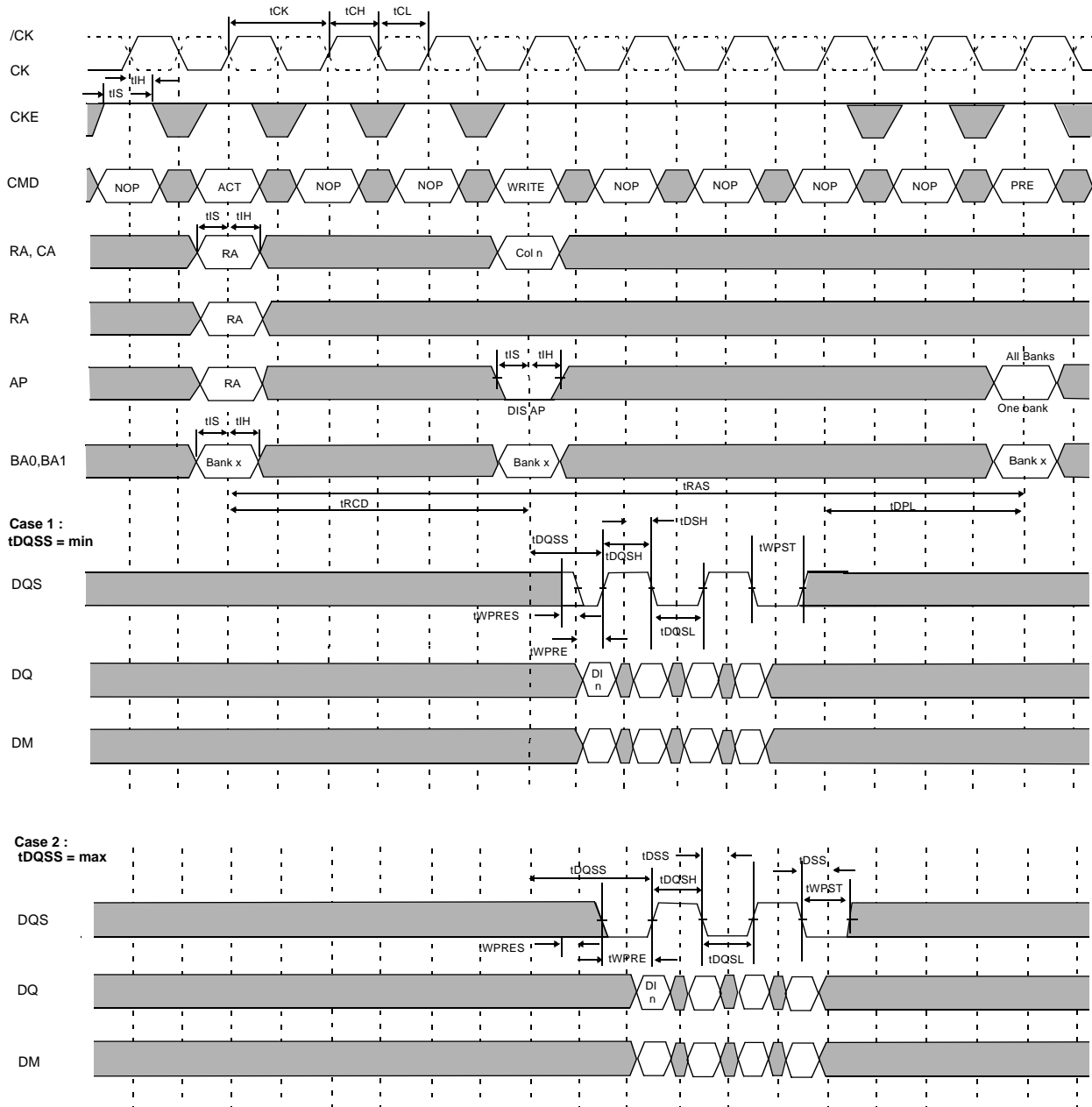
* = "Dont Care", if AP is high at this point

ACT=Active, RA=Row Address, BA=Bank Address

NOP commands are shown for ease of illustration; other valid commands may be possible at these times

 Dont care

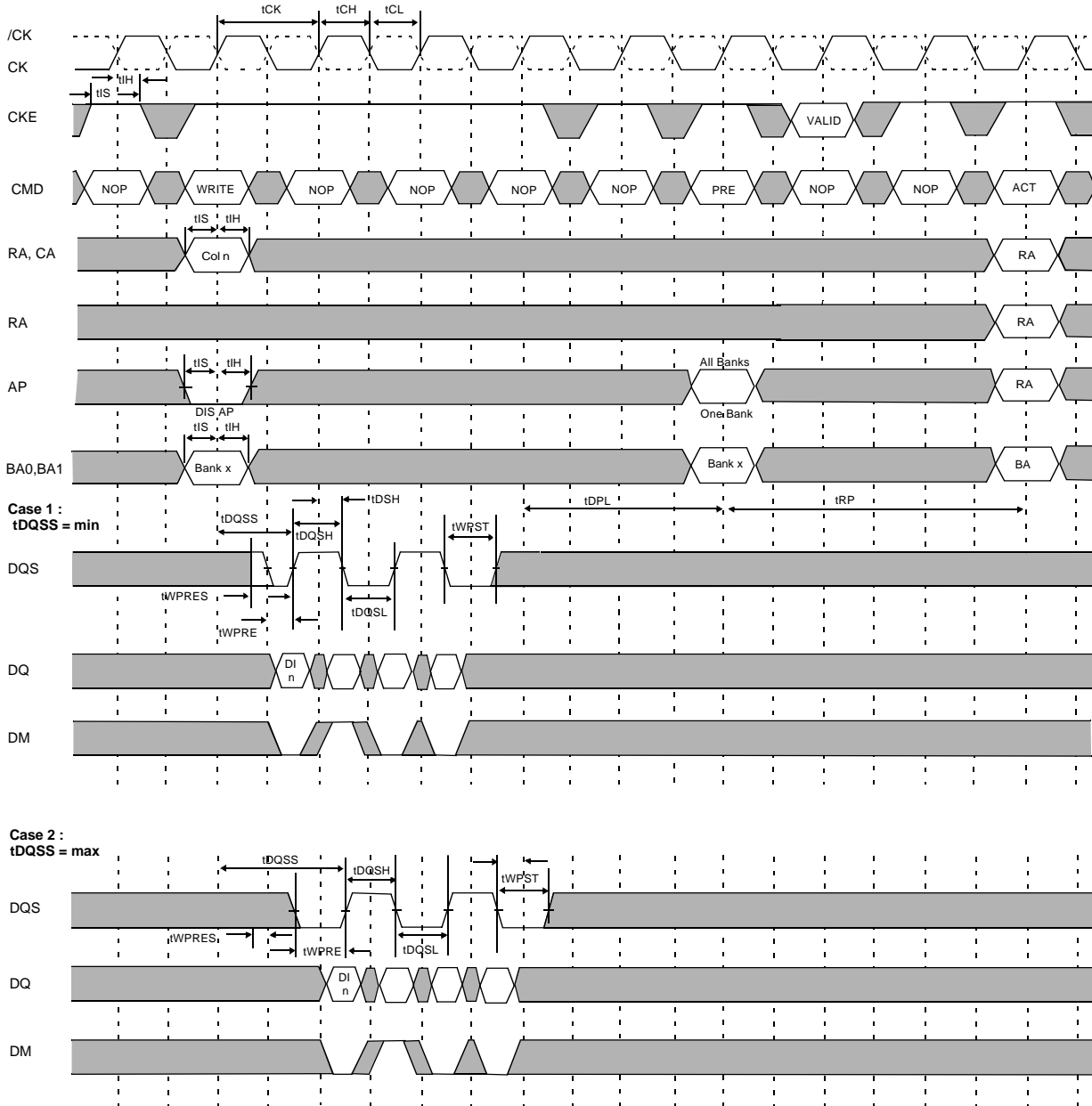
Bank Write Access



DI n = Data in for column n
 Burst length = 4 in the case shown
 3 subsequent elements of Data In are applied in the programmed order following Data In
 DIS AP = Disable Autoprecharge
 * = "Dont Care", if AP is high at this point
 PRE=Precharge, ACT=Active, RA=Row Address
 NOP commands are shown for ease of illustration; other valid commands may be possible at these times

Dont care

Write DM Operation



DI n = Data in for column n

Burst length = 4 in the case shown

3 subsequent elements of Data In are applied in the programmed order following Data In (the second element of the four is masked)

DIS AP = Enable Autoprecharge

* = * "Dont Care", if AP is high at this point

PRE=Precharge, ACT=Active, RA=Row Address, BA=Bank Address

NOP commands are shown for ease of illustration; other valid commands may be possible at these times