

## 256K x 4 Bit CMOS Dynamic RAM with Fast Page Mode

## DESCRIPTION

This is a family of 262,144 x 4 bit Fast Page Mode CMOS DRAMs. Fast Page Mode offers high speed random access of memory cells within the same row. Access time(-6, -7 or -8), power consumption (Normal or Low power), and package type (SOJ, ZIP,DIP) are optional features of this family. All of this family have CAS-before-RAS refresh, RAS-only refresh and Hidden refresh capabilities.

This 256Kx4 Fast Page Mode DRAM Family is fabricated using Samsung's advanced CMOS process to realize high band-width, low power consumption and high reliability.

## FEATURES

- Part Identification  
- KM44C256D/D-L(5V)

- Active Power Dissipation

Unit : mW

Speed	Active Power Dissipation
-6	385
-7	358
-8	330

- Refresh cycles

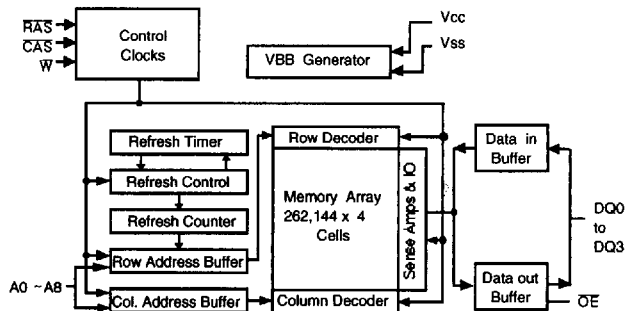
Part No.	Refresh Cycle	Refresh period	
		Normal	L
KM44C256D	512	8ms	128ms

- Performance range:

Speed	t <sub>RAC</sub>	t <sub>CAC</sub>	t <sub>RC</sub>	t <sub>PC</sub>
-6	60ns	15ns	110ns	40ns
-7	70ns	20ns	130ns	45ns
-8	80ns	20ns	150ns	50ns

- Fast Page Mode operation
- CAS-before-RAS refresh capability
- RAS-only and Hidden refresh capability
- TTL(5V) compatible inputs and outputs
- Early write or Output Enable controlled write
- JEDEC Standard pinout
- Available in Plastic SOJ, ZIP, and DIP packages
- Single +5V±10% power supply

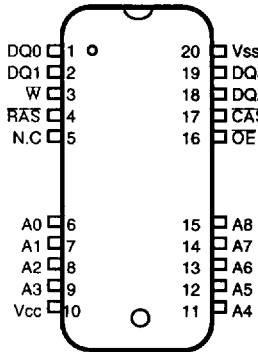
## FUNCTIONAL BLOCK DIAGRAM



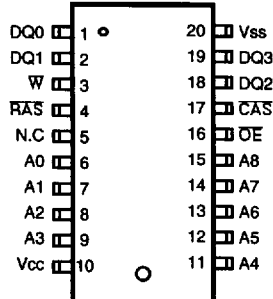
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## PIN CONFIGURATION (Top Views)

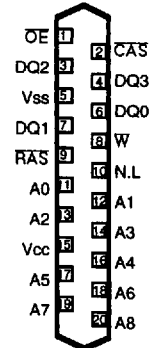
• KM44C256DJ



• KM44C256DP



• KM44C256DZ



Pin Name	Pin Function
A0 - A8	Address Inputs
DQ0~3	Data In/out
Vss	Ground
RAS	Row Address Strobe
CAS	Column Address Strobe
W	Read/Write Input
OE	Data Outputs Enable
Vcc	Power(+5.0V)
N.C	No Connection
N.L	No Lead

## ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Rating	Units
Voltage on any pin relative to $V_{SS}$	$V_{IN}, V_{OUT}$	-1 to +7.0	V
Voltage on $V_{CC}$ supply relative to $V_{SS}$	$V_{CC}$	-1 to +7.0	V
Storage temperature	Tstg	-55 to +150	°C
Power dissipation	$P_D$	600	mW
Short circuit output current	$I_{OS}$	50	mA

\* Permanent device damage may occur if "ABSOLUTE MAXIMUM RATINGS" are exceeded. Functional operation should be restricted to the conditions as detailed in the operational sections of this data sheet. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

RECOMMENDED OPERATING CONDITIONS (Voltages referenced to  $V_{SS}$ ,  $T_A = 0$  to  $70^\circ\text{C}$ )

Parameter	Symbol	Min	Typ	Max	Unit
Supply voltage	$V_{CC}$	4.5	5.0	5.5	V
Ground	$V_{SS}$	0	0	0	V
Input high voltage	$V_{IH}$	2.4	-	$V_{CC}+1^{*1}$	V
Input low voltage	$V_{IL}$	-2.0 <sup>*2</sup>	-	0.8	V

\*1 :  $V_{CC}+2.0\text{V}$  at pulse width  $\leq 20\text{ns}$  (pulse width is measured at  $V_{CC}$ )

\*2 :  $-2.0\text{V}$  at pulse width  $\leq 20\text{ns}$  (pulse is measured at  $V_{SS}$ )

## DC AND OPERATING CHARACTERISTICS (Recommended operating conditions unless otherwise noted.)

Parameter	Symbol	Min	Max	Units
Input leakage current (Any input $0 \leq V_{IN} \leq V_{CC}+0.5\text{V}$ all other pins not under test=0 volts.)	$I_{IL}$	- 5	5	$\mu\text{A}$
Output leakage current (Data out is disabled, $0\text{V} \leq V_{OUT} \leq V_{CC}$ )	$I_{OL}$	- 5	5	$\mu\text{A}$
Output high voltage level( $I_{OH}=-5\text{mA}$ )	$V_{OH}$	2.4	-	V
Output low voltage level( $I_{OL}=4.2\text{mA}$ )	$V_{OL}$	-	0.4	V

## DC AND OPERATING CHARACTERISTICS (Recommended operating conditions unless otherwise noted.)

Symbol	Power	Speed	Max	Units
			KM44C256D	
I <sub>CC1</sub>	Don't care	•		
		-6	60	mA
		-7	55	mA
		-8	50	mA
I <sub>CC2</sub>	Don't care	Don't care	2	mA
I <sub>CC3</sub>	Don't care	-6	60	mA
		-7	55	mA
		-8	50	mA
I <sub>CC4</sub>	Don't care	-6	50	mA
		-7	45	mA
		-8	40	mA
I <sub>CC5</sub>	Normal L	Don't care	1	mA
			100	μA
I <sub>CC6</sub>	Don't care	-6	60	mA
		-7	55	mA
		-8	50	mA
I <sub>CC7</sub>	L	Don't care	100	μA

I<sub>CC1</sub>\* : Operating current ( $\overline{RAS}$  and  $\overline{CAS}$ , Address cycling @t<sub>RC</sub>=min.)

I<sub>CC2</sub> : Standby current ( $\overline{RAS}=\overline{CAS}=\overline{W}=V_{IH}$ )

I<sub>CC3</sub>\* :  $\overline{RAS}$ -only refresh current ( $\overline{CAS}=V_{IH}$ ,  $\overline{RAS}$ , Address cycling @t<sub>RC</sub>=min.)

I<sub>CC4</sub>\* : Fast Page Mode current ( $\overline{RAS}=V_{IL}$ ,  $\overline{CAS}$ , Address cycling @t<sub>PC</sub>=min.)

I<sub>CC5</sub> : Standby current ( $\overline{RAS}=\overline{CAS}=\overline{W}=V_{CC}-0.2V$ )

I<sub>CC6</sub>\* :  $\overline{CAS}$ -before- $\overline{RAS}$  refresh current ( $\overline{RAS}$  and  $\overline{CAS}$  cycling @t<sub>RC</sub>=min.)

I<sub>CC7</sub> : Battery back-up current, Average power supply current, Battery back-up mode

Input high voltage( $V_{IH}$ )= $V_{CC}-0.2V$ , Input low voltage( $V_{IL}$ )= $0.2V$ ,  $\overline{CAS}=\overline{CAS}$ -before- $\overline{RAS}$  cycling or  $0.2V$

D<sub>IN</sub>= $\overline{W}=A0 \sim A8 = V_{CC}-0.2V$  or  $0.2V$ , T<sub>RC</sub>=125μs(L-ver), T<sub>RAS</sub>=T<sub>RASmin</sub>~300 ns

\* NOTE : I<sub>CC1</sub>, I<sub>CC3</sub>, I<sub>CC4</sub> and I<sub>CC6</sub> are dependent on output loading and cycle rates. Specified values are obtained with the output open. I<sub>CC</sub> is specified as an average current. In I<sub>CC1</sub>, I<sub>CC3</sub> and I<sub>CC6</sub>, address can be changed maximum once while  $\overline{RAS}=V_{IL}$ . In I<sub>CC4</sub>, Address can be changed maximum once within one fast page mode cycle time t<sub>PC</sub>.

**CAPACITANCE** ( $T_A=25^{\circ}\text{C}$ ,  $V_{CC}=5\text{V}$ ,  $f=1\text{MHz}$ )

Parameter	Symbol	Min	Max	Unit
Input capacitance [A0 - A8]	$C_{IN1}$	-	6	pF
Input capacitance [ $\overline{\text{RAS}}$ , $\overline{\text{CAS}}$ , W, OE]	$C_{IN2}$	-	7	pF
Output capacitance [DQ0~DQ3]	$C_{OUT}$	-	7	pF

**AC CHARACTERISTICS** ( $0^{\circ}\text{C} \leq T_A \leq 70^{\circ}\text{C}$ , See note 1,2)Test condition :  $V_{CC}=5.0\text{V} \pm 10\%$ ,  $V_{IH}/V_{IL}=2.4/0.8\text{V}$ ,  $V_{OH}/V_{OL}=2.0/0.8\text{V}$ 

Parameter	Symbol	- 6		- 7		- 8		Units	Notes
		Min	Max	Min	Max	Min	Max		
Random read or write cycle time	tRC	110		130		150		ns	
Read-modify-write cycle time	tRWC	155		175		195		ns	
Access time from $\overline{\text{RAS}}$	tRAC		60		70		80	ns	3,4,10
Access time from $\overline{\text{CAS}}$	tCAC		15		20		20	ns	3,4,5
Access time from column address	tAA		30		35		40	ns	3,9
$\overline{\text{CAS}}$ to output in Low-Z	tCLZ	0		0		0		ns	3
Output buffer turn-off delay	tOFF	0	15	0	20	0	20	ns	6
Transition time (rise and fall)	tT	3	50	3	50	3	50	ns	2
$\overline{\text{RAS}}$ precharge time	tRP	40		50		60		ns	
$\overline{\text{RAS}}$ pulse width	tRAS	60	10K	70	10K	80	10K	ns	
$\overline{\text{RAS}}$ hold time	tRSH	15		20		20		ns	
$\overline{\text{CAS}}$ hold time	tCSH	60		70		80		ns	
$\overline{\text{CAS}}$ pulse width	tCAS	15	10K	20	10K	20	10K	ns	
$\overline{\text{RAS}}$ to $\overline{\text{CAS}}$ delay time	tRCD	20	45	20	50	20	60	ns	4
$\overline{\text{RAS}}$ to column address delay time	tRAD	15	30	15	35	15	40	ns	10
$\overline{\text{CAS}}$ to $\overline{\text{RAS}}$ precharge time	tCRP	5		5		5		ns	
Row address set-up time	tASR	0		0		0		ns	
Row address hold time	tRAH	10		10		10		ns	
Column address set-up time	tASC	0		0		0		ns	
Column address hold time	tCAH	15		15		15		ns	
Column address hold time referenced to $\overline{\text{RAS}}$	tAR	50		55		60		ns	11
Column address to $\overline{\text{RAS}}$ lead time	tRAL	30		35		40		ns	
Read command set-up time	tRCS	0		0		0		ns	
Read command hold time referenced to $\overline{\text{CAS}}$	tRCH	0		0		0		ns	8
Read command hold time referenced to $\overline{\text{RAS}}$	tRRH	0		0		0		ns	8
Write command hold time	tWCH	10		10		10		ns	
Write command hold time referenced to $\overline{\text{RAS}}$	tWCR	45		50		55		ns	11
Write command pulse width	tWP	10		10		10		ns	
Write command to $\overline{\text{RAS}}$ lead time	tRWL	15		15		15		ns	
Write command to $\overline{\text{CAS}}$ lead time	tCWL	15		15		15		ns	

AC CHARACTERISTICS (0°C ≤ T<sub>A</sub> ≤ 70°C, See note 2)

Parameter	Symbol	- 6		- 7		- 8		Units	Notes
		Min	Max	Min	Max	Min	Max		
Data set-up time	t <sub>DS</sub>	0		0		0		ns	9
Data hold time	t <sub>DH</sub>	15		15		15		ns	9
Data hold time referenced to RAS	t <sub>DHR</sub>	50		55		60		ns	11
Refresh period(Normal)	t <sub>REF</sub>		8		8		8	ms	
Refresh period(L-ver)	t <sub>REF</sub>		128		128		128	ms	
Write command set-up time	t <sub>WCS</sub>	0		0		0		ns	7
CAS to W delay time	t <sub>CWD</sub>	40		45		45		ns	7
RAS to W delay time	t <sub>RWD</sub>	85		95		105		ns	7
Column address to W delay time	t <sub>AWD</sub>	55		60		65		ns	7
CAS precharge to W delay time	t <sub>CPWD</sub>	60		65		70		ns	
CAS set-up time (CAS-before-RAS refresh)	t <sub>CSR</sub>	5		5		5		ns	
CAS hold time (CAS-before-RAS refresh)	t <sub>CHR</sub>	15		15		15		ns	
RAS to CAS precharge time	t <sub>RPC</sub>	5		5		5		ns	
CAS precharge time(CBR counter test cycle)	t <sub>CPT</sub>	20		25		30		ns	
Access time from CAS precharge	t <sub>CPA</sub>		35		35		40	ns	3
Fast Page mode cycle time	t <sub>PC</sub>	40		45		50		ns	
Fast Page mode read-modify-write cycle time	t <sub>PRWC</sub>	80		85		90		ns	
CAS precharge time (Fast page cycle)	t <sub>CP</sub>	10		10		10		ns	
RAS pulse width (Fast page cycle)	t <sub>RASP</sub>	60	100K	70	100K	80	100K	ns	
RAS hold time from CAS precharge	t <sub>RHCP</sub>	40		45		50		ns	
OE access time	t <sub>OEa</sub>		15		20		20	ns	
OE to data delay	t <sub>OED</sub>	15		20		20		ns	
Output buffer turn off delay time from OE	t <sub>OEZ</sub>	0	15	0	20	0	20	ns	
OE command hold time	t <sub>OEh</sub>	15		20		20		ns	

## NOTES

1. An initial pause of 200 $\mu$ s is required after power up followed by any 8 ROR or CBR cycles before proper device operation is achieved.
2.  $V_{IH}(\min)$  and  $V_{IL}(\max)$  are reference levels for measuring timing of input signals. Transition times are measured between  $V_{IH}(\min)$  and  $V_{IL}(\max)$  and are assumed to be 5ns for all inputs.
3. Measured with a load equivalent to 2 TTL loads and 100pF.
4. Operation within the  $t_{RCD}(\max)$  limit insures that  $t_{RAC}(\max)$  can be met.  $t_{RCD}(\max)$  is specified as a reference point only. If  $t_{RCD}(\max)$  is greater than the specified  $t_{RCD}(\max)$  limit, then access time is controlled exclusively by  $t_{CAC}$ .
5. Assumes that  $t_{RCD} \geq t_{RCD}(\max)$ .
6. This parameter defines the time at which the output achieves the open circuit condition and is not referenced to  $V_{oh}$  or  $V_{ol}$ .
7.  $t_{WCS}$ ,  $t_{RWD}$ ,  $t_{CWD}$  and  $t_{AWD}$  are non restrictive operating parameters. They are included in the data sheet as electrical characteristics only. If  $t_{WCS} \geq t_{WCS}(\min)$ , the cycle is an early write cycle and the data output will remain high impedance for the duration of the cycle. If  $t_{CWD} \geq t_{CWD}(\min)$ ,  $t_{RWD} \geq t_{RWD}(\min)$  and  $t_{AWD} \geq t_{AWD}(\min)$ , then the cycle is a read-modify-write cycle and the data output will contain the data read from the selected address. If neither of the above conditions is satisfied, the condition of the data out is indeterminate.
8. Either  $t_{RCH}$  or  $t_{RRH}$  must be satisfied for a read cycle.
9. These parameters are referenced to the  $\overline{CAS}$  leading edge in early write cycles and to the  $\overline{W}$  leading edge in read-modify-write cycles.
10. Operation within the  $t_{RAD}(\max)$  limit insures that  $t_{RAC}(\max)$  can be met.  $t_{RAD}(\max)$  is specified as a reference point only. If  $t_{RAD}$  is greater than the specified  $t_{RAD}(\max)$  limit, then access time is controlled by  $t_{AA}$ .
11.  $t_{AR}$ ,  $t_{WCR}$ , and  $t_{DHR}$  are referenced to  $t_{RAD}(\max)$ .