2M x 8Bit CMOS Dynamic RAM with Fast Page Mode

DESCRIPTION

This is a family of 2,097,152 x 8 bit Fast Page Mode CMOS DRAMs. Fast Page Mode offers high speed random access of memory cells within the same row. Power supply voltage (+5.0V or +3.3V), refresh cycle (2K Ref. or 4K Ref.), access time (-5,-6 or -7), power consumption(Normal or Low power) and package type(SOJ or TSOP-II) are optional features of this family. All of this family have $\overline{CAS}$-before-$\overline{RAS}$ refresh, $\overline{RAS}$-only refresh and Hidden refresh capabilities. Furthermore, Self-refresh operation is available in L-version.

This 2Mx8 Fast Page Mode DRAM family is fabricated using Samsung's advanced CMOS process to realize high band-width, low power consumption and high reliability.

It may be used as graphic memory unit for microcomputer, personal computer and portable machines.

FEATURES

- **Part Identification**

  - KM48C2000B/B-L (5V, 4K Ref.)
  - KM48C2100B/B-L (5V, 2K Ref.)
  - KM48V2000B/B-L (3.3V, 4K Ref.)
  - KM48V2100B/B-L (3.3V, 2K Ref.)

- **Active Power Dissipation**

Unit : mW

Speed	3.3V		5V	
	4K	2K	4K	2K
-5	324	396	495	605
-6	288	360	440	550
-7	252	324	385	495

- **Refresh Cycles**

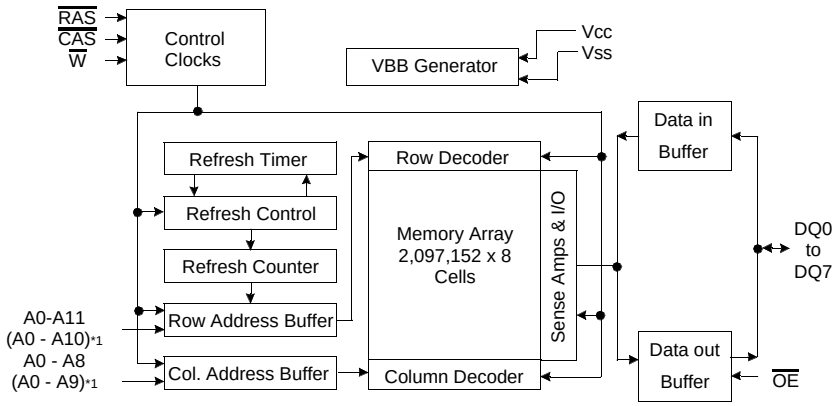
Part NO.	V_{CC}	Refresh cycle	Refresh period	
			Normal	L-ver
C2000B	5V	4K	64ms	128ms
V2000B	3.3V			
C2100B	5V	2K	32ms	
V2100B	3.3V			

- **Performance Range**

Speed	t_{RAC}	t_{CAC}	t_{RC}	t_{PC}	Remark
-5	50ns	13ns	90ns	35ns	5V/3.3V
-6	60ns	15ns	110ns	40ns	5V/3.3V
-7	70ns	20ns	130ns	45ns	5V/3.3V

- Fast Page Mode operation
- Byte/Word Read/Write operation
- $\overline{CAS}$-before-$\overline{RAS}$ refresh capability
- $\overline{RAS}$-only and Hidden refresh capability
- Self-refresh capability (L-ver only)
- Fast parallel test mode capability
- TTL(5V)/LVTTL(3.3V) compatible inputs and outputs
- Early Write or output enable controlled write
- JEDEC Standard pinout
- Available in Plastic SOJ and TSOP(II) packages
- Single +5V¡¾10% power supply (5V product)
- Single +3.3V¡¾0.3V power supply (3.3V product)

FUNCTIONAL BLOCK DIAGRAM



Note) *1 : 2K Refresh

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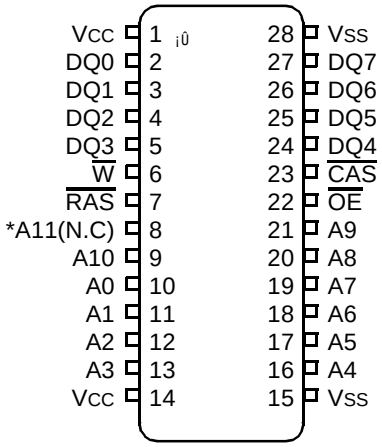
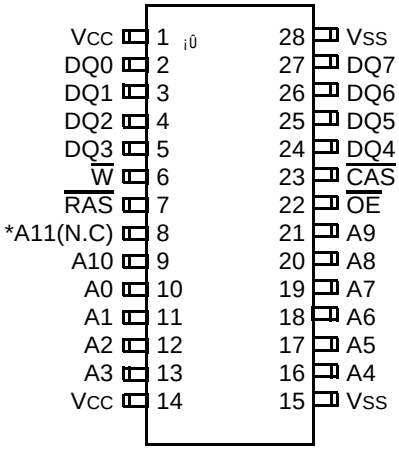
PIN CONFIGURATION (Top Views)

KM48C/V20(1)00BK



KM48C/V20(1)00BS



*A11 is N.C for KM48C/V2100B(5V/3.3V, 2K Ref. product)

K : 300mil 28 SOJ
S : 300mil 28 TSOP II

Pin Name	Pin Function
A0 - A11	Address Inputs (4K Product)
A0 - A10	Address Inputs (2K Product)
DQ0 - 7	Data In/Out
VSS	Ground
$\overline{RAS}$	Row Address Strobe
$\overline{CAS}$	Column Address Strobe
$\overline{W}$	Read/Write Input
$\overline{OE}$	Data Output Enable
VCC	Power(+5V)
	Power(+3.3V)
N.C	No Connection (2K Ref. product)

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Rating		Units
		3.3V	5V	
Voltage on any pin relative to Vss	VIN,VOUT	-0.5 to +4.6	-1.0 to +7.0	V
Voltage on Vcc supply relative to Vss	Vcc	-0.5 to +4.6	-1.0 to +7.0	V
Storage Temperature	Tstg	-55 to +150	-55 to +150	¡É
Power Dissipation	PD	1	1	W
Short Circuit Output Current	IOS	50	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 (Voltage referenced to Vss, TA= 0 to 70¡É)

Parameter	Symbol	3.3V			5V			Units
		Min	Typ	Max	Min	Typ	Max	
Supply Voltage	Vcc	3.0	3.3	3.6	4.5	5.0	5.5	V
Ground	Vss	0	0	0	0	0	0	V
Input High Voltage	VIH	2.0	-	Vcc+0.3*1	2.4	-	Vcc+1.0*1	V
Input Low Voltage	VIL	-0.3*2	-	0.8	-1.0*2	-	0.8	V

*1 : Vcc+1.3V/15ns(3.3V), Vcc+2.0V/20ns(5V), Pulse width is measured at Vcc
*2 : -1.3V/15ns(3.3V), -2.0V/20ns(5V), Pulse width is measured at Vss

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

Max	Parameter	Symbol	Min	Max	Units
3.3V	Input Leakage Current (Any input 0¡ÂVIN¡ÂVIN+0.3V, all other input pins not under test=0 Volt)	II(L)	-5	5	uA
	Output Leakage Current (Data out is disabled, 0V¡ÂVOUT¡ÂVcc)	IO(L)	-5	5	uA
	Output High Voltage Level(IOH=-2mA)	VOH	2.4	-	V
	Output Low Voltage Level(IOL=2mA)	VOL	-	0.4	V
5V	Input Leakage Current (Any input 0¡ÂVIN¡ÂVIN+0.5V, all other input pins not under test=0 Volt)	II(L)	-5	5	uA
	Output Leakage Current (Data out is disabled, 0V¡ÂVOUT¡ÂVcc)	IO(L)	-5	5	uA
	Output High Voltage Level(IOH=-5mA)	VOH	2.4	-	V
	Output Low Voltage Level(IOL=4.2mA)	VOL	-	0.4	V

DC AND OPERATING CHARACTERISTICS (Continued)

Symbol	Power	Speed	Max				Units
			KM48V2000B	KM48V2100B	KM48C2000B	KM48C2100B	
I_{CC1}	Don't care	-5 -6 -7	90 80 70	110 100 90	90 80 70	110 100 90	mA mA mA
I_{CC2}	Normal L	Don't care	1 1	1 1	2 1	2 1	mA mA
I_{CC3}	Don't care	-5 -6 -7	90 80 70	110 100 90	90 80 70	110 100 90	mA mA mA
I_{CC4}	Don't care	-5 -6 -7	80 70 60	90 80 70	80 70 60	90 80 70	mA mA mA
I_{CC5}	Normal L	Don't care	0.5 0.3	0.5 0.3	1 0.3	1 0.3	mA uA
I_{CC6}	Don't care	-5 -6 -7	90 80 70	110 100 90	90 80 70	110 100 90	mA mA mA
I_{CC7}	L	Don't care	450	400	450	400	uA
I_{CCS}	L	Don't care	250	250	300	300	uA

I_{CC1}* : Operating Current ($\overline{RAS}$ and $\overline{CAS}$ cycling @t_{RC}=min.)

I_{CC2} : Standby Current ($\overline{RAS}$=$\overline{CAS}$=$\overline{W}$=V_{IH})

I_{CC3}* : $\overline{RAS}$-only Refresh Current ($\overline{CAS}$=V_{IH}, $\overline{RAS}$ cycling @t_{RC}=min.)

I_{CC4}* : Fast Page Mode Current ($\overline{RAS}$=V_{IL}, $\overline{CAS}$, Address cycling @t_{PC}=min.)

I_{CC5} : Standby Current ($\overline{RAS}$=$\overline{CAS}$=$\overline{W}$=V_{CC}-0.2V)

I_{CC6}* : $\overline{CAS}$-Before-$\overline{RAS}$ Refresh Current ($\overline{RAS}$ and $\overline{CAS}$ cycling @t_{RC}=min.)

I_{CC7} : 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, $\overline{CAS}$=0.2V,
Din=Don't care, T_{RC}=31.25us(4K/L-ver), 62.5us(2K/L-ver),
T_{RAS}=T_{RAS}min~300ns

I_{CCS} : Self Refresh Current
$\overline{RAS}$=$\overline{CAS}$=V_{IL}, $\overline{W}$=$\overline{OE}$=A0 ~ A11=V_{CC}-0.2V or 0.2V,
DQ0 ~ DQ7=V_{CC}-0.2V, 0.2V or Open

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

CAPACITANCE (T_A=25¡É, V_{CC}=5V or 3.3V, f=1MHz)

Parameter	Symbol	Min	Max	Units
Input capacitance [A0 ~ A11]	C_{IN1}	-	5	pF
Input capacitance [$\overline{RAS}$, $\overline{CAS}$, $\overline{W}$, $\overline{OE}$]	C_{IN2}	-	7	pF
Output capacitance [DQ0 - DQ7]	C_{DQ}	-	7	pF

AC CHARACTERISTICS (0¡É¡ÂT_A¡Â70¡É, See note 1,2)

Test condition (5V device) : V_{CC}=5.0V¡¾10%, Vih/Vil=2.4/0.8V, Voh/Vol=2.4/0.4V
Test condition (3.3V device) : V_{CC}=3.3V¡¾0.3V, Vih/Vil=2.0/0.8V, Voh/Vol=2.0/0.8V

Parameter	Symbol	-5		-6		-7		Units	Notes
		Min	Max	Min	Max	Min	Max		
Random read or write cycle time	t_{RC}	90		110		130		ns	
Read-modify-write cycle time	t_{RWC}	133		155		185		ns	
Access time from $\overline{RAS}$	t_{RAC}		50		60		70	ns	3,4,9
Access time from $\overline{CAS}$	t_{CAC}		13		15		20	ns	3,4
Access time from column address	t_{AA}		25		30		35	ns	3,9
$\overline{CAS}$ to output in Low-Z	t_{CLZ}	0		0		0		ns	3
Output buffer turn-off delay	t_{OFF}	0	13	0	15	0	20	ns	5
Transition time (rise and fall)	t_T	3	50	3	50	3	50	ns	2
$\overline{RAS}$ precharge time	t_{RP}	30		40		50		ns	
$\overline{RAS}$ pulse width	t_{RAS}	50	10K	60	10K	70	10K	ns	
$\overline{RAS}$ hold time	t_{RSH}	13		15		20		ns	
$\overline{CAS}$ hold time	t_{CSH}	50		60		70		ns	
$\overline{CAS}$ pulse width	t_{CAS}	13	10K	15	10K	20	10K	ns	
$\overline{RAS}$ to $\overline{CAS}$ delay time	t_{RCD}	20	37	20	45	20	50	ns	4
$\overline{RAS}$ to column address delay time	t_{RAD}	15	25	15	30	15	35	ns	9
$\overline{CAS}$ to $\overline{RAS}$ precharge time	t_{CRP}	5		5		5		ns	
Row address set-up time	t_{ASR}	0		0		0		ns	
Row address hold time	t_{RAH}	10		10		10		ns	
Column address set-up time	t_{ASC}	0		0		0		ns	
Column address hold time	t_{CAH}	10		10		15		ns	
Column address to $\overline{RAS}$ lead time	t_{RAL}	25		30		35		ns	
Read command set-up time	t_{RCS}	0		0		0		ns	
Read command hold time referenced to $\overline{CAS}$	t_{RCH}	0		0		0		ns	7
Read command hold time referenced to $\overline{RAS}$	t_{RRH}	0		0		0		ns	7
Write command hold time	t_{WCH}	10		10		15		ns	
Write command pulse width	t_{WP}	10		10		15		ns	
Write command to $\overline{RAS}$ lead time	t_{RWL}	13		15		20		ns	
Write command to $\overline{CAS}$ lead time	t_{CWL}	13		15		20		ns	

AC CHARACTERISTICS (Continued)

Parameter	Symbol	-5		-6		-7		Units	Notes
		Min	Max	Min	Max	Min	Max		
Data set-up time	t_{DS}	0		0		0		ns	8
Data hold time	t_{DH}	10		10		15		ns	8
Refresh period (2K, Normal)	t_{REF}		32		32		32	ms	
Refresh period (4K, Normal)	t_{REF}		64		64		64	ms	
Refresh period (L-ver)	t_{REF}		128		128		128	ms	
Write command set-up time	t_{WCS}	0		0		0		ns	6
$\overline{CAS}$ to $\overline{W}$ delay time	t_{CWD}	36		40		50		ns	6
$\overline{RAS}$ to $\overline{W}$ delay time	t_{RWD}	73		85		100		ns	6
Column address to $\overline{W}$ delay time	t_{AWD}	48		55		65		ns	6
$\overline{CAS}$ precharge to $\overline{W}$ delay time	t_{CPWD}	53		60		70		ns	6
$\overline{CAS}$ set-up time ($\overline{CAS}$ -before-$\overline{RAS}$ refresh)	t_{CSR}	5		5		5		ns	
$\overline{CAS}$ hlod time ($\overline{CAS}$ -before-$\overline{RAS}$ refresh)	t_{CHR}	10		10		15		ns	
$\overline{RAS}$ to $\overline{CAS}$ precharge time	t_{RPC}	5		5		5		ns	
$\overline{CAS}$ precharge time (CBR counter test	t_{CPT}	20		20		30		ns	
Access time from $\overline{CAS}$ precharge	t_{CPA}		30		35		40	ns	3
Fast Page mode cycle time	t_{PC}	35		40		45		ns	
Fast Page read-modify-write cycle time	t_{PRWC}	76		85		100		ns	
$\overline{CAS}$ precharge time (Fast Page cycle)	t_{CP}	10		10		10		ns	
$\overline{RAS}$ pulse width (Fast Page cycle)	t_{RASP}	50	200K	60	200K	70	200K	ns	
$\overline{RAS}$ hold time from $\overline{CAS}$ precharge	t_{RHCP}	30		35		40		ns	
$\overline{OE}$ access time	t_{OEA}		13		15		20	ns	
$\overline{OE}$ to data delay	t_{OED}	13		15		20		ns	
Output buffer turn off delay time from $\overline{OE}$	t_{OEZ}	0	13	0	15	0	20	ns	5
$\overline{OE}$ command hold time	t_{OEH}	13		15		20		ns	
Write command set-up time (Test mode in)	t_{WTS}	10		10		10		ns	10
Write command hold time (Test mode in)	t_{WTH}	10		10		10		ns	10
$\overline{W}$ to $\overline{RAS}$ precharge time(C-B-R refresh)	t_{WRP}	10		10		10		ns	
$\overline{W}$ to $\overline{RAS}$ hold time(C-B-R refresh)	t_{WRH}	10		10		10		ns	
$\overline{RAS}$ pulse width (C-B-R self refresh)	t_{RASS}	100		100		100		us	12
$\overline{RAS}$ precharge time (C-B-R self refresh)	t_{RPS}	90		110		130		ns	12
$\overline{CAS}$ hold time (C-B-R self refresh)	t_{CHS}	-50		-50		-50		ns	12

TEST MODE CYCLE

(Note 10, 11)

Parameter	Symbol	-5		-6		-7		Units	Notes
		Min	Max	Min	Max	Min	Max		
Random read or write cycle time	t_{RC}	95		115		135		ns	
Read-modify-write cycle time	t_{RWC}	138		160		190		ns	
Access time from $\overline{RAS}$	t_{RAC}		55		65		75	ms	3,4,9
Access time from $\overline{CAS}$	t_{CAC}		18		20		25	ms	3,4
Access time from column address	t_{AA}		30		35		40	ms	3,9
$\overline{RAS}$ pulse width	t_{RAS}	55	10K	65	10K	75	10K	ns	
$\overline{CAS}$ pulse width	t_{CAS}	18	10K	20	10K	25	10K	ns	
$\overline{RAS}$ hold time	t_{RSH}	18		20		25		ns	
$\overline{CAS}$ hold time	t_{CSH}	55		65		75		ns	
Column address to $\overline{RAS}$ lead time	t_{RAL}	30		35		40		ns	
$\overline{CAS}$ to $\overline{W}$ delay time	t_{CWD}	41		45		55		ns	6
$\overline{RAS}$ to $\overline{W}$ delay time	t_{RWD}	78		90		105		ns	6
Column address to $\overline{W}$ delay time	t_{AWD}	53		60		70		ns	6
$\overline{CAS}$ precharge to $\overline{W}$ delay timerefresh)	t_{CPWD}	58		65		75		ns	6
Fast Page mode cycle time	t_{PC}	40		45		50		ns	
Fast Page read-modify-write cycle time	t_{PRWC}	81		90		105		ns	
$\overline{RAS}$ pulse width (Fast Page cycle)	t_{RASP}	55	200K	65	200K	75	200K	ns	
Access time from $\overline{CAS}$ precharge	t_{CPA}		35		40		45	ns	3
$\overline{OE}$ access time	t_{OEA}		18		20		25	ns	
$\overline{OE}$ to data delay	t_{OED}	18		20		25		ns	
$\overline{OE}$ command hold time	t_{OEH}	18		20		25		ns	

NOTES

1. An initial pause of 200us is required after power-up followed by any 8 ROR or $\overline{CBR}$ 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(5V)/1TTL(3.3V) 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} is greater than the specified t_{RCD}(max) limit, then access time is controlled exclusively by t_{CAC}.
5. This parameter defines the time at which the output achieves the open circuit condition and is not referenced to V_{oh} or V_{ol}.
6. t_{WCS}, t_{RWD}, t_{CWD}, t_{AWD} and t_{CPWD} are non restrictive operating parameters. They are included in the data sheet as electrical characteristics only. If $t_{WCS} \geq t_{WCS}$(min), the cycles 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), $t_{AWD} \geq t_{AWD}$(min) and $t_{CPWD} \geq t_{CPWD}$(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.
7. Either t_{RCH} or t_{RRH} must be satisfied for a read cycle.
8. These parameters are referenced to the $\overline{CAS}$ falling edge in ealy write cycles and to the $\overline{W}$ falling edge in $\overline{OE}$ controlled write cycle and read-modify-write cycles.
9. 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}.
10. These specifications are applied in the test mode.
11. In test mode read cycle, the values of t_{RAC}, t_{AA} and t_{CAC} are delayed by 2ns to 5ns for the specified values. These parameters should be specified in test mode cycles by adding 5ns to the specified value in this data sheet.
12. For all of the refresh modes except for distributed $\overline{CAS}$ -before- $\overline{RAS}$ refresh, 4096(4K Ref.)/2048(2K Ref.) cycles of burst refresh must be executed within 16ms before and after self-refresh in order to meet refresh specification.