

4Mx32 SDRAM
90FBGA
(VDD 2.5V, VDDQ 2.5V)

Revision 0.1

November 2001

Revision History**Revision 0.0 (Nov. 16. 2001, Final)**

- Final generation for 4Mx32 2.5V SDRAM FBGA.

Revision 0.1 (Jan. 14. 2002, Final)

- Changed of Icc3N from 50mA to 60mA and Icc3NS from 30mA to 50mA.

1M x 32Bit x 4 Banks SDRAM in 90FBGA**FEATURES**

- 2.5V power supply
- LVTTTL compatible with multiplexed address
- Four banks operation
- MRS cycle with address key programs
 - CAS latency (1 & 2 & 3)
 - Burst length (1, 2, 4, 8 & Full page)
 - Burst type (Sequential & Interleave)
- All inputs are sampled at the positive going edge of the system clock
- Burst read single-bit write operation
- DQM for masking
- Auto & self refresh
- 64ms refresh period (4K cycle).
- Extended Temperature Operation (-25°C ~ 85°C).
- 90Balls FBGA based on 2 pcs of 4Mx16 SDRAM.

GENERAL DESCRIPTION

The K4S283234F is 134,217,728 bits synchronous high data rate Dynamic RAM organized as 4 x 1,048,576 words by 32 bits, fabricated with SAMSUNG's high performance CMOS technology. Synchronous design allows precise cycle control with the use of system clock and I/O transactions are possible on every clock cycle. Range of operating frequencies, programmable burst length and programmable latencies allow the same device to be useful for a variety of high bandwidth, high performance memory system applications.

ORDERING INFORMATION

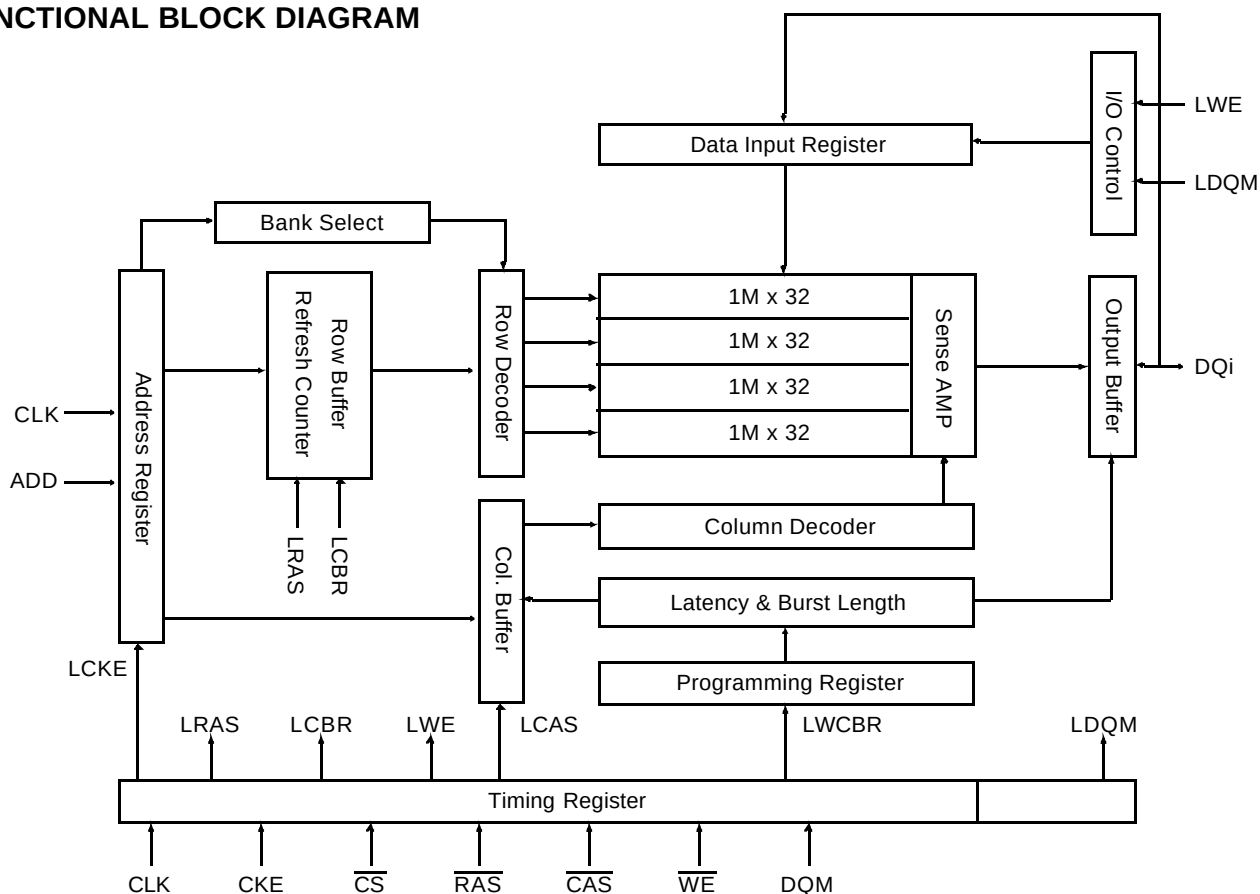
Part No.	Max Freq.	Interface	Package
K4S283234F-ME/N1L	100MHz(CL=3) ^{*1}	LVTTTL	90 Balls FBGA
K4S283234F-ME/N15	66MHz(CL=2) ^{*2}		

- ME ; Normal Power, Extended Temperature.

- MN ; Low Power, Extended Temperature.

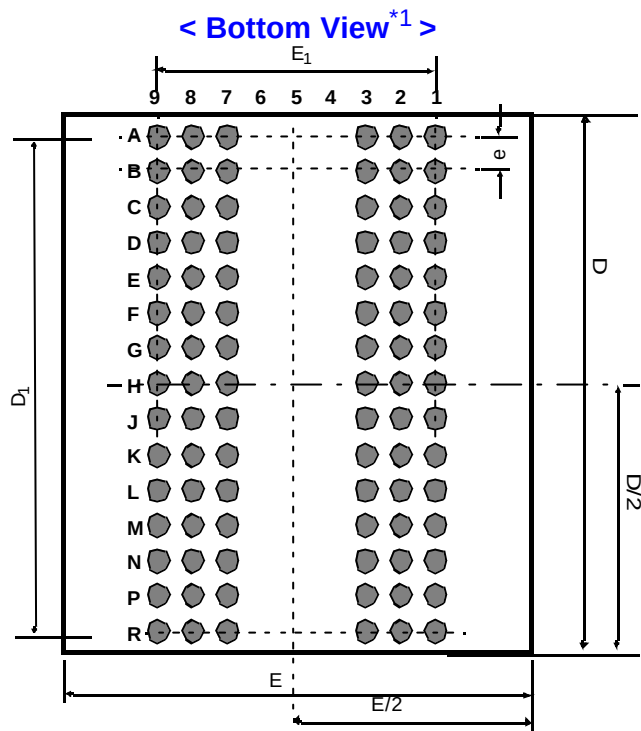
Note :1. In case of 40MHz Frequency, CL1 can be supported.

2. In case of 33MHz Frequency, CL1 can be supported.

FUNCTIONAL BLOCK DIAGRAM

* Samsung Electronics reserves the right to change products or specification without notice.

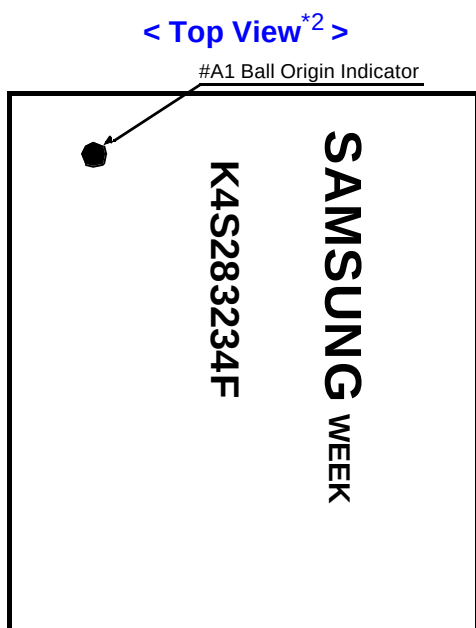
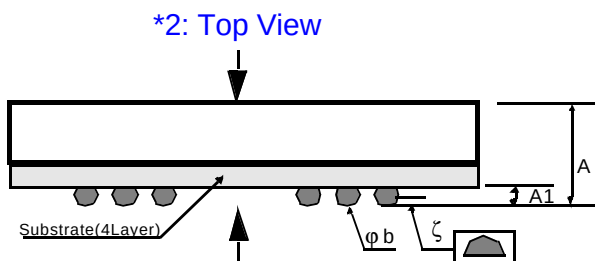
Package Dimension and Pin Configuration



< Top View *2 >

90Ball(6x15) CSP

	1	2	3	7	8	9
A	DQ26	DQ24	VSS	VDD	DQ23	DQ21
B	DQ28	VDDQ	VSSQ	VDDQ	VSSQ	DQ19
C	VSSQ	DQ27	DQ25	DQ22	DQ20	VDDQ
D	VSSQ	DQ29	DQ30	DQ17	DQ18	VDDQ
E	VDDQ	DQ31	NC	NC	DQ16	VSSQ
F	VSS	DQM3	A3	A2	DQM2	VDD
G	A4	A5	A6	A10	A0	A1
H	A7	A8	NC	NC	BA1	A11
J	CLK	CKE	A9	BA0	$\overline{CS}$	$\overline{RAS}$
K	DQM1	NC	NC	$\overline{CAS}$	$\overline{WE}$	DQM0
L	VDDQ	DQ8	VSS	VDD	DQ7	VSSQ
M	VSSQ	DQ10	DQ9	DQ6	DQ5	VDDQ
N	VSSQ	DQ12	DQ14	DQ1	DQ3	VDDQ
P	DQ11	VDDQ	VSSQ	VDDQ	VSSQ	DQ4
R	DQ13	DQ15	VSS	VDD	DQ0	DQ2



Pin Name	Pin Function
CLK	System Clock
$\overline{CS}$	Chip Select
CKE	Clock Enable
A0 ~ A11	Address
BA0 ~ BA1	Bank Select Address
$\overline{RAS}$	Row Address Strobe
$\overline{CAS}$	Column Address Strobe
$\overline{WE}$	Write Enable
DQM0 ~ DQM3	Data Input/Output Mask
DQ0 ~ 31	Data Input/Output
VDD/VSS	Power Supply/Ground
VDDQ/VSSQ	Data Output Power/Ground

[Unit:mm]

Symbol	Min	Typ	Max
A	1.35	1.40	1.45
A1	0.30	0.35	0.40
E	-	11.00	-
E1	-	6.40	-
D	-	13.00	-
D1	-	11.20	-
e	-	0.80	-
φb	0.40	0.45	0.50
ζ	-	-	0.10

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Value	Unit
Voltage on any pin relative to Vss	V _{IN} , V _{OUT}	-1.0 ~ 3.6	V
Voltage on V _{DD} supply relative to Vss	V _{DD} , V _{DDQ}	-1.0 ~ 3.6	V
Storage temperature	T _{STG}	-55 ~ +150	°C
Power dissipation	P _D	1	W
Short circuit current	I _{OS}	50	mA

Note : Permanent device damage may occur if ABSOLUTE MAXIMUM RATINGS are exceeded.
Functional operation should be restricted to recommended operating condition.
Exposure to higher than recommended voltage for extended periods of time could affect device reliability.

DC OPERATING CONDITIONS

Recommended operating conditions (Voltage referenced to Vss = 0V, T_A = -25 to 85°C)

Parameter	Symbol	Min	Typ	Max	Unit	Note
Supply voltage	V _{DD}	2.3	2.5	2.7	V	
	V _{DDQ}	2.3	2.5	2.7	V	
Input logic high voltage	V _{IH}	0.9 x V _{DDQ}	2.5	V _{DDQ} + 0.3	V	1
Input logic low voltage	V _{IL}	-0.3	0	0.3	V	2
Output logic high voltage	V _{OH}	0.95 x V _{DDQ}	-	-	V	I _{OH} = -2mA
Output logic low voltage	V _{OL}	-	-	0.2	V	I _{OL} = 2mA
Input leakage current	I _{LI}	-10	-	10	uA	3

Note : 1. V_{IH} (max) = 3.0V AC. The overshoot voltage duration is ≤ 3ns.
2. V_{IL} (min) = -1.0V AC. The undershoot voltage duration is ≤ 3ns.
3. Any input 0V ≤ V_{IN} ≤ V_{DDQ}.
Input leakage currents include HI-Z output leakage for all bi-directional buffers with Tri-State outputs.
4. Dout is disabled, 0V ≤ V_{OUT} ≤ V_{DDQ}.

CAPACITANCE (V_{DD} = 2.5V, T_A = 23°C, f = 1MHz, V_{REF} = 0.9V ± 50 mV)

Pin	Symbol	Min	Max	Unit	Note
Clock	C _{CLK}	4.0	8.0	pF	
$\overline{\text{RAS}}$, $\overline{\text{CAS}}$, $\overline{\text{WE}}$, $\overline{\text{CS}}$, CKE, DQM	C _{IN}	4.0	8.0	pF	
Address	C _{ADD}	4.0	8.0	pF	
DQ ₀ ~ DQ ₃₁	C _{OUT}	3.0	6.5	pF	

DC CHARACTERISTICS

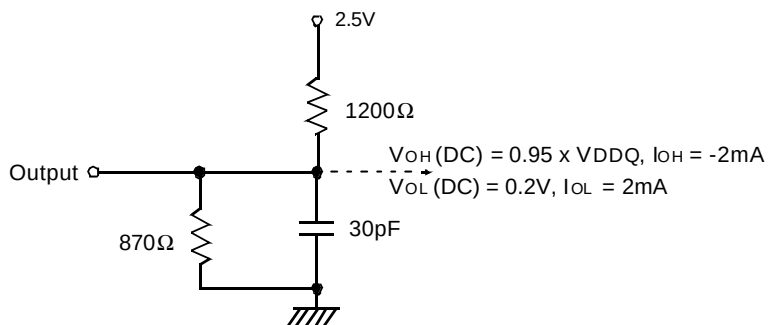
Recommended operating conditions (Voltage referenced to V_{SS} = 0V, T_A = -25 to 85°C)

Parameter	Symbol	Test Condition		Version		Unit	Note
				-1H	-1L		
Operating Current (One Bank Active)	I _{CC1}	Burst length = 1 t _{RC} ≥ t _{RC} (min) I _O = 0 mA		140	130	mA	1
Precharge Standby Current in power-down mode	I _{CC2P}	CKE ≤ V _{IL} (max), t _{CC} = 10ns		2		mA	
	I _{CC2PS}	CKE & CLK ≤ V _{IL} (max), t _{CC} = ∞		2			
Precharge Standby Current in non power-down mode	I _{CC2N}	CKE ≥ V _{IH} (min), $\overline{CS}$ ≥ V _{IH} (min), t _{CC} = 10ns Input signals are changed one time during 20ns		30		mA	
	I _{CC2NS}	CKE ≥ V _{IH} (min), CLK ≤ V _{IL} (max), t _{CC} = ∞ Input signals are stable		12			
Active Standby Current in power-down mode	I _{CC3P}	CKE ≤ V _{IL} (max), t _{CC} = 10ns		6		mA	
	I _{CC3PS}	CKE & CLK ≤ V _{IL} (max), t _{CC} = ∞		6			
Active Standby Current in non power-down mode (One Bank Active)	I _{CC3N}	CKE ≥ V _{IH} (min), $\overline{CS}$ ≥ V _{IH} (min), t _{CC} = 10ns Input signals are changed one time during 20ns		60		mA	
	I _{CC3NS}	CKE ≥ V _{IH} (min), CLK ≤ V _{IL} (max), t _{CC} = ∞ Input signals are stable		50		mA	
Operating Current (Burst Mode)	I _{CC4}	I _O = 0 mA Page burst 4Banks Activated t _{CCD} = 2CLKs		180	170	mA	1
Refresh Current	I _{CC5}	t _{RC} ≥ t _{RC} (min)		220	210	mA	2
Self Refresh Current	I _{CC6}	CKE ≤ 0.2V	-ME	2		mA	3
			-MN	800		uA	4

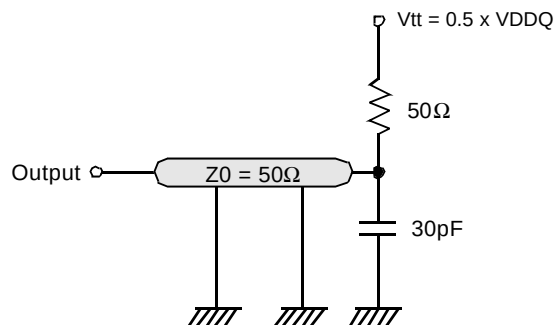
- Notes :**
1. Measured with outputs open.
 2. Refresh period is 64ms.
 3. K4S283234F-ME**
 4. K4S283234F-MN**
 5. Unless otherwise noted, input swing level is CMOS(V_{IH}/V_{IL}=V_{DDQ}/V_{SSQ})

AC OPERATING TEST CONDITIONS ($V_{DD} = 2.5V \pm 0.2V$, $T_A = -25$ to 85°C)

Parameter	Value	Unit
AC input levels (V_{ih}/V_{il})	$0.95 \times V_{DDQ} / 0.2$	V
Input timing measurement reference level	$0.5 \times V_{DDQ}$	V
Input rise and fall time	$t_r/t_f = 1/1$	ns
Output timing measurement reference level	$0.5 \times V_{DDQ}$	V
Output load condition	See Fig. 2	



(Fig. 1) DC output load circuit



(Fig. 2) AC output load circuit

OPERATING AC PARAMETER

(AC operating conditions unless otherwise noted)

Parameter		Symbol	Version		Unit	Note
			-1L	-15		
Row active to row active delay		tRRD(min)	20	30	ns	1
RAS to CAS delay		tRCD(min)	24	30	ns	1
Row precharge time		tRP(min)	24	30	ns	1
Row active time		tRAS(min)	60	60	ns	1
		tRAS(max)	100		us	
Row cycle time		tRC(min)	84	90	ns	1
Last data in to row precharge		tRDL(min)	2		CLK	2
Last data in to Active delay		tDAL(min)	2 CLK + tRP		-	
Last data in to new col. address delay		tCDL(min)	1		CLK	2
Last data in to burst stop		tBDL(min)	1		CLK	2
Col. address to col. address delay		tCCD(min)	1		CLK	3
Number of valid output data	CAS latency=3		2		ea	4
	CAS latency=2		1			
	CAS latency=1		0			

Notes : 1. The minimum number of clock cycles is determined by dividing the minimum time required with clock cycle time and then rounding off to the next higher integer.

2. Minimum delay is required to complete write.

3. All parts allow every cycle column address change.

4. In case of row precharge interrupt, auto precharge and read burst stop.

AC CHARACTERISTICS (AC operating conditions unless otherwise noted)

Parameter		Symbol	-1L		-15		Unit	Note
			Min	Max	Min	Max		
CLK cycle time	CAS latency=3	tcc	10	1000	15	1000	ns	1
	CAS latency=2		12		15			
	CAS latency=1		25		30			
CLK to valid output delay	CAS latency=3	tsac		7		9	ns	1,2
	CAS latency=2			8		9		
	CAS latency=1			20		24		
Output data hold time	CAS latency=3	toH	2.5		2.5		ns	2
	CAS latency=2		2.5		2.5			
	CAS latency=1		2.5		2.5			
CLK high pulse width		tCH	3		3.5		ns	3
CLK low pulse width		tCL	3		3.5		ns	3
Input setup time		tss	2.5		3.5		ns	3
Input hold time		tSH	1.5		2.0		ns	3
CLK to output in Low-Z		tsLZ	1		1		ns	2
CLK to output in Hi-Z	CAS latency=3	tSHZ		7		9	ns	
	CAS latency=2			8		9		
	CAS latency=1			20		24		

- Notes :**
- Parameters depend on programmed CAS latency.
 - If clock rising time is longer than 1ns, $(tr/2-0.5)ns$ should be added to the parameter.
 - Assumed input rise and fall time (tr & tf) = 1ns.
If tr & tf is longer than 1ns, transient time compensation should be considered,
i.e., $[(tr + tf)/2-1]ns$ should be added to the parameter.

SIMPLIFIED TRUTH TABLE

COMMAND			CKEn-1	CKEn	$\overline{CS}$	$\overline{RAS}$	$\overline{CAS}$	$\overline{WE}$	DQM	BA0,1	A10/AP	A11, A9 ~ A0	Note		
Register	Mode Register Set		H	X	L	L	L	L	X	OP CODE			1, 2		
Refresh	Auto Refresh		H	H	L	L	L	H	X	X			3		
	Self Refresh	Entry		L									3		
		Exit	L	H	L	H	H	H	X	X			3		
													3		
Bank Active & Row Addr.			H	X	L	L	H	H	X	V	Row Address				
Read & Column Address	Auto Precharge Disable		H	X	L	H	L	H	X	V	L	Column Address (A0 ~ A7)	4		
	Auto Precharge Enable										H		4, 5		
Write & Column Address	Auto Precharge Disable		H	X	L	H	L	L	X	V	L	Column Address (A0 ~ A7)	4		
	Auto Precharge Enable										H		4, 5		
Burst Stop			H	X	L	H	H	L	X	X			6		
Precharge	Bank Selection		H	X	L	L	H	L	X	V	L	X			
	All Banks									X	H				
Clock Suspend or Active Power Down		Entry	H	L	H	X	X	X	X	X					
					L	V	V	V							
		Exit	L	H	X	X	X	X	X	X					
Precharge Power Down Mode		Entry	H	L	H	X	X	X	X	X					
					L	H	H	H							
		Exit	L	H	H	X	X	X	X						
					L	V	V	V							
DQM			H	X					V	X			7		
No Operation Command			H	X	H	X	X	X	X	X					
					L	H	H	H							

(V=Valid, X=Don't Care, H=Logic High, L=Logic Low)

Note : 1. OP Code : Operand CodeA₀ ~ A₁₁ & BA₀ ~ BA₁ : Program keys. (@MRS)

2. MRS can be issued only at all banks precharge state.

A new command can be issued after 2 CLK cycles of MRS.

3. Auto refresh functions are as same as CBR refresh of DRAM.

The automatical precharge without row precharge command is meant by "Auto".

Auto/self refresh can be issued only at all banks precharge state.

4. BA₀ ~ BA₁ : Bank select addresses.If both BA₀ and BA₁ are "Low" at read, write, row active and precharge, bank A is selected.If BA₀ is "Low" and BA₁ is "High" at read, write, row active and precharge, bank B is selected.If BA₀ is "High" and BA₁ is "Low" at read, write, row active and precharge, bank C is selected.If both BA₀ and BA₁ are "High" at read, write, row active and precharge, bank D is selected.If A₁₀/AP is "High" at row precharge, BA₀ and BA₁ is ignored and all banks are selected.

5. During burst read or write with auto precharge, new read/write command can not be issued.

Another bank read/write command can be issued after the end of burst.

New row active of the associated bank can be issued at t_{RP} after the end of burst.

6. Burst stop command is valid at every burst length.

7. DQM sampled at the positive going edge of CLK masks the data-in at that same CLK in write operation (Write DQM latency is 0), but in read operation makes the data-out Hi-Z state after 2 CLK cycles. (Read DQM latency is 2).

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