

# DRAM MODULE

# 16 Mega Byte

## KMM5394100AM Fast Page Mode

4Mx39 DRAM SIMM , 2K Refresh , 5V  
Using 16M DRAM with 400 mil Package

### GENERAL DESCRIPTION

The Samsung KMM5394100AM is a 4M bit x 39 Dynamic RAM high density memory module. The Samsung KMM5394100AM consists of ten CMOS 4Mx4bit DRAMs in 24-pin SOJ packages mounted on a 72-pin glass-epoxy substrate. A 0.22uF decoupling capacitor is mounted on the printed circuit board for each DRAM. The KMM5394100AM is a Single In-line Memory Module with edge connections and is intended for mounting into 72 pin edge connector sockets.

### FEATURES

- Performance Range:
 

	tRAC	tCAC	tRC
KMM5394100AM - 5	50ns	13ns	90ns
KMM5394100AM - 6	60ns	15ns	110ns
KMM5394100AM - 7	70ns	20ns	130ns
KMM5394100AM - 8	80ns	20ns	150ns
- Fast Page Mode Operation
- $\overline{CAS}$ -before- $\overline{RAS}$  refresh capability
- $\overline{RAS}$ -only and Hidden refresh capability
- TTL compatible inputs and outputs
- Single +5V±10% power supply
- 2048 cycles/32 ms refresh
- JEDEC standard PDPin & pinout
- PCB : Height (1000 mil), double sided component

### PIN CONFIGURATIONS

Pin	Symbol	Pin	Symbol
1	Vss	37	DQ33
2	DQ0	38	DQ35
3	DQ16	39	Vss
4	DQ1	40	$\overline{CAS0}$
5	DQ17	41	$\overline{CAS2}$
6	DQ2	42	$\overline{CAS3}$
7	DQ18	43	$\overline{CAS1}$
8	DQ3	44	$\overline{RAS0}$
9	DQ19	45	NC
10	Vcc	46	DQ37
11	A10	47	W
12	A0	48	Vss
13	A1	49	DQ8
14	A2	50	DQ24
15	A3	51	DQ9
16	A4	52	DQ25
17	A5	53	DQ10
18	A6	54	DQ26
19	$\overline{OE}$	55	DQ11
20	DQ4	56	DQ27
21	DQ20	57	DQ12
22	DQ5	58	DQ28
23	DQ21	59	Vcc
24	DQ6	60	DQ29
25	DQ22	61	DQ13
26	DQ7	62	DQ30
27	DQ23	63	DQ14
28	A7	64	DQ31
29	DQ36	65	DQ15
30	Vcc	66	DQ38
31	A8	67	PD1
32	A9	68	PD2
33	NC	69	PD3
34	$\overline{RAS2}$	70	PD4
35	DQ34	71	NC
36	DQ32	72	Vss

### PIN NAMES

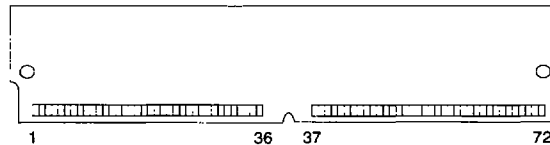
A0 - A10	Address Inputs
DQ0 - DQ38	Data In/Out
W	Read/Write Input
$\overline{RAS0}$ , $\overline{RAS2}$	Row Address Strobe
$\overline{CAS0}$ - $\overline{CAS3}$	Column Address Strobe
PD1 - PD4	Presence Detect
Vcc	Power(+5V)
Vss	Ground
NC	No Connection
$\overline{OE}$	Output Enable

### PRESENCE DETECT PINS (Optional)

Pin	50NS	60NS	70NS	80NS
PD1			NC	
PD2	TBD	TBD	NC	TBD
PD3			Vss	
PD4			Vss	

\*Pin Connection Changing Available

### PIN CONNECTIONS (Front View)



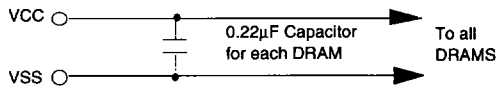
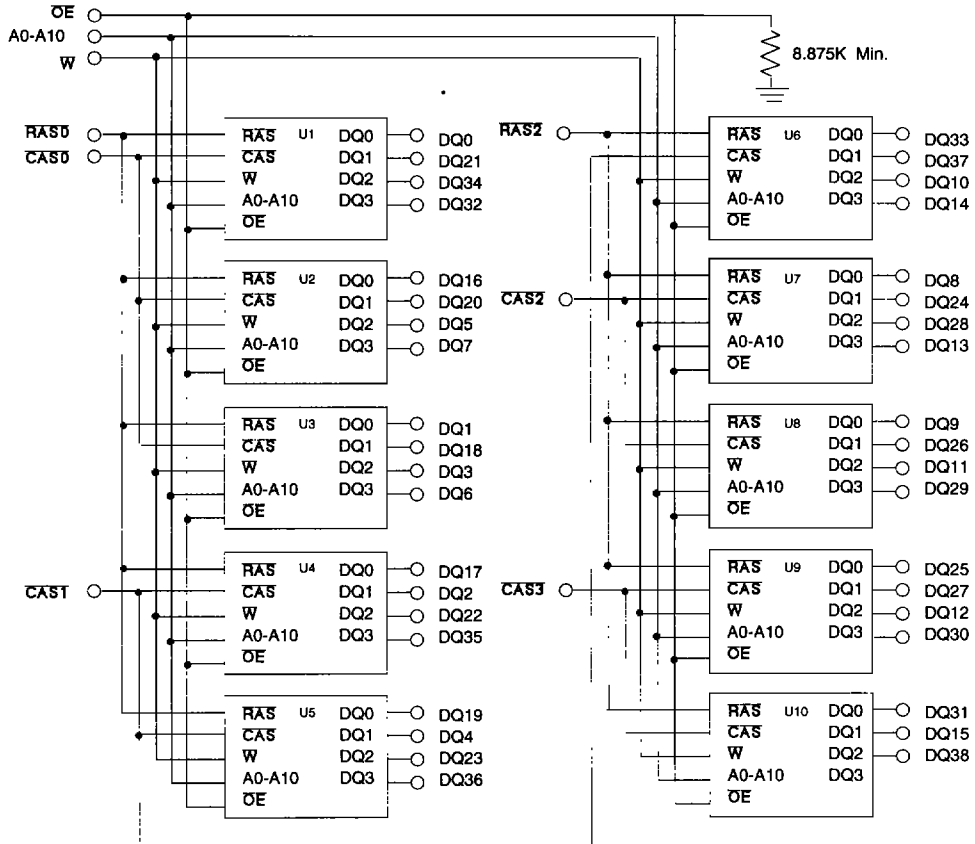
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## FUNCTIONAL BLOCK DIAGRAM



## ABSOLUTE MAXIMUM RATINGS \*

Item	Symbol	Rating	Unit
Voltage on any pin relative to Vss	VIN, VOUT	-1 to +7.0	V
Voltage on Vcc supply relative to Vss	Vcc	-1 to +7.0	V
Storage Temperature	Tstg	-55 to +150	°C
Power Dissipation	Pd	10	W
Short Circuit Output Current	IOS	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 intended periods may affect device reliability.

## RECOMMENDED OPERATING CONDITIONS (Voltage referenced to Vss, Ta = 0 to 70 °C)

Item	Symbol	Min	Typ	Max	Unit
Supply Voltage	Vcc	4.5	5.0	5.5	V
Ground	Vss	0	0	0	V
Input High Voltage	VIH	2.4	-	Vcc+1	V
Input Low Voltage	VIL	-1.0	-	0.8	V

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

Parameter	Part No	Symbol	Min	Max	Unit
Operating Current * (RAS, CAS, Address cycling @tRC=min.)	KMM5394100AM - 5	ICC1	-	1100	mA
	KMM5394100AM - 6		-	1000	mA
	KMM5394100AM - 7		-	900	mA
	KMM5394100AM - 8		-	800	mA
Standby Current (RAS=CAS=W=VIH)		ICC2	-	20	mA
RAS Only Refresh Current * (CAS= VIH, RAS cycling @tRC =min.)	KMM5394100AM - 5	ICC3	-	1100	mA
	KMM5394100AM - 6		-	1000	mA
	KMM5394100AM - 7		-	900	mA
	KMM5394100AM - 8		-	800	mA
Fast Page Mode Current * (RAS=VIL, CAS cycling : tPC=min.)	KMM5394100AM - 5	ICC4	-	900	mA
	KMM5394100AM - 6		-	800	mA
	KMM5394100AM - 7		-	700	mA
	KMM5394100AM - 8		-	600	mA
Standby Current (RAS=CAS=W=Vcc-0.2V)		ICC5	-	10	mA
CAS-Before-RAS Refresh Current * (RAS and CAS cycling @tRC =min.)	KMM5394100AM - 5	ICC6	-	1100	mA
	KMM5394100AM - 6		-	1000	mA
	KMM5394100AM - 7		-	900	mA
	KMM5394100AM - 8		-	800	mA
Input Leakage Current (Any input 0 ≤ VIN ≤ Vcc+0.5V, all other pins not under test = 0 V.)		II(L)	-100	100	µA
Output Leakage Current (Data out is disabled, 0V ≤ Vout ≤ Vcc)		IO(L)	-10	10	µA
Output High Voltage Level (IOH = - 5mA)		VOH	2.4	-	V
Output Low Voltage Level (IOL = 4.2mA)		VOL	-	0.4	V

\* NOTE : ICC1, ICC3, ICC4 and ICC6 are dependent on output loading and cycle rates. Specified values are obtained with the output open. ICC is specified as an average current. In ICC1 and ICC3, address can be changed maximum two times while RAS=VIL. In ICC4, address can be changed maximum once within one page mode cycle.

## CAPACITANCE (Ta = 25°C, Vcc=5V, f = 1 MHz)

Item	Symbol	Min	Max	Unit
Input capacitance [A0-A10]	CIN1	-	80	pF
Input capacitance [W, OE]	CIN2	-	90	pF
Input capacitance [RAS0, RAS2]	CIN3	-	90	pF
Input capacitance [CAS0 - CAS3]	CIN4	-	90	pF
Input/Output capacitance [DQ0-38]	CDQ1	-	17	pF

AC CHARACTERISTICS (0°C ≤ Ta ≤ 70°C, Vcc = 5.0V ± 10%. See notes 1,2.)

STANDARD OPERATION	Symbol	-5		-6		-7		-8		Unit	Notes
		Min	Max	Min	Max	Min	Max	Min	Max		
Random read or write cycle time	IRC	90		110		130		150		ns	
Access time from RAS	IRAC	50		60		70		80		ns	3,4
Access time from CAS	ICAC	13		15		20		20		ns	3,4,5
Access time from column address	IAA	25		30		35		40		ns	3,11
CAS to output in Low-Z	ICLZ	0		0		0		0		ns	3
Output buffer turn-off delay	IOFF	0 13		0 15		0 20		0 20		ns	7
Transition time (rise and fall)	IT	3 50		3 50		3 50		3 50		ns	2
RAS precharge time	IRP	30		40		50		60		ns	
RAS pulse width	IRAS	50 10K		60 10K		70 10K		80 10K		ns	
RAS hold time	IRSH	13		15		20		20		ns	
CAS hold time	ICSH	50		60		70		80		ns	
CAS pulse width	ICAS	13 10K		15 10K		20 10K		20 10K		ns	
RAS to CAS delay time	IRCD	20 37		20 45		20 50		20 60		ns	4
RAS to column address delay time	IRAD	15 25		15 30		15 35		15 40		ns	11
CAS to RAS precharge time	ICRP	5		5		5		5		ns	
Row address set-up time	IASR	0		0		0		0		ns	
Row address hold time	IRAH	10		10		10		10		ns	
Column address set-up time	IASC	0		0		0		0		ns	
Column address hold time	ICAH	10		10		15		15		ns	
Column address hold referenced to RAS	IAR	40		45		55		60		ns	6
Column Address to RAS lead time	IRAL	25		30		35		40		ns	
Read command set-up time	IRCS	0		0		0		0		ns	
Read command hold reference* to CAS	IRCH	0		0		0		0		ns	9
Read command hold referenced to RAS	IRRH	0		0		0		0		ns	9
Write command hold time	IWCH	10		10		15		15		ns	
Write command hold referenced to RAS	IWCR	40		45		55		60		ns	6
Write command pulse width	IWP	10		10		15		15		ns	
Write command to RAS lead time	IRWL	15		15		20		20		ns	
Write command to CAS lead time	ICWL	13		15		20		20		ns	
Data-in set-up time	IDS	0		0		0		0		ns	10
Data-in hold time	IDH	10		10		15		15		ns	10
Data-in hold referenced to RAS	IDHR	40		45		55		60		ns	6
Refresh period	IREF	32		32		32		32		ms	
Write command set-up time	IWCS	0		0		0		0		ns	8
CAS setup time (C-B-R refresh)	ICSR	10		10		10		10		ns	
CAS hold time (C-B-R refresh)	ICHR	10		10		15		15		ns	
RAS precharge to CAS hold time	IRPC	5		5		5		5		ns	
Access time from CAS precharge	ICPA	30		35		40		45		ns	3
Fast Page mode cycle time	IPC	35		40		45		50		ns	
CAS precharge time (Fast page)	ICP	10		10		10		10		ns	
RAS pulse width (Fast page)	IRASP	50 200K		60 200K		70 200K		80 200K		ns	
W to RAS precharge time (C-B-R refresh)	IWRP	10		10		10		10		ns	
W to RAS hold time (C-B-R refresh)	IWRH	10		10		10		10		ns	
CAS precharge (C-B-R counter test)	ICPT	20		20		30		30		ns	

STANDARD OPERATION	Symbol	-5		-6		-7		-8		Unit	Notes
		Min	Max	Min	Max	Min	Max	Min	Max		
OE Access time	IOEA		13		15		20		20	ns	
OE to data delay	IOED	15		15		20		20		ns	
Output buffer turn off delay time from OE	IOEZ	0	15	0	15	0	20	0	20	ns	
OE command hold time	IOEH	13		15		20		20		ns	
RAS hold time referenced to OE	tROH	13		15		20		20		ns	

## NOTES

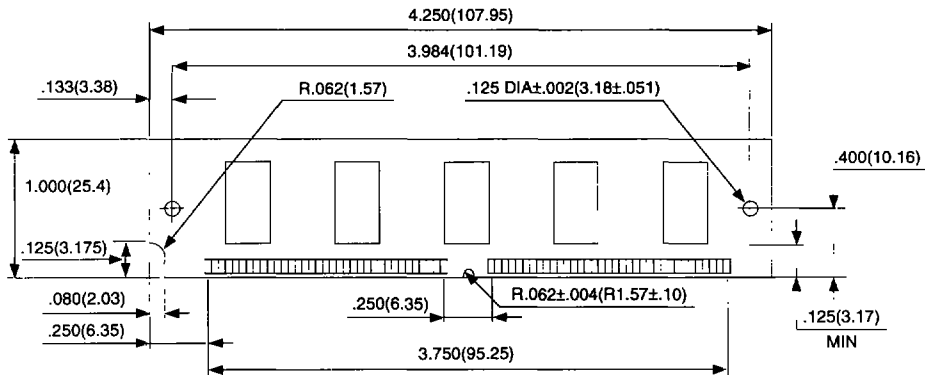
1. An initial pause of 200µs is required after power-up followed by any 8 RAS-only or CAS-before-RAS refresh cycles before proper device operation is achieved.
2. VIH (min) and VIL (max) are reference levels for measuring timing of input signals. Transition times are measured between VIH(min) and VIL(max) 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 tRCD(max) limit insures that tRAC(max) can be met. tRCD(max) is specified as a reference point only. If tRCD is greater than the specified tRCD(max) limit, then access time is controlled exclusively by tCAC.
5. Assumes that tRCD ≥ tRCD(max).
6. tAR, tWCR, tDHR are referenced to tRAD(MAX)
7. This parameter defines the time at which the output achieves the open circuit condition and is not referenced to VOH or VOL.
8. tWCS is non restrictive operating parameter. It included in the data sheet as electrical characteristic only. If tWCS ≥ tWCS(min) the cycle is an early write cycle and the data out pin will remain high impedance for the duration of the cycle.
9. Either tRCH or tRRH must be satisfied for a read cycle.
10. These parameters are referenced to the CAS leading edge in early write cycles.
11. Operation within the tRAD(max) limit insures that tRAC(max) can be met. tRAD(max) is specified as reference point only. If tRAD is greater than the specified tRAD(max) limit, then access time is controlled by tAA.

## TIMING DIAGRAM

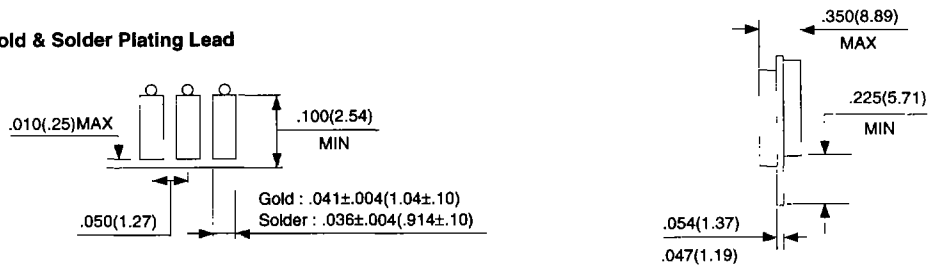
Please refer to attached timing chart (II) !

## PACKAGE DIMENSIONS

Units : Inches ( millimeters )



### Gold & Solder Plating Lead



Tolerances :  $\pm 0.005$  (.13) unless otherwise specified

NOTE : The used device is 4Mx4 DRAM , SOJ .  
DRAM Part No. : KM44C4100AJ (400 mil)

Revision History  
Rev 0.0 : 22 Dec. '93