GENERAL DESCRIPTION

The HYM5321600A M-Series is a 16Mx32-bit Fast Page mode CMOS DRAM module consisting of thirty-two HY5116100B in 24/26 pin SOJ or TSOP-II on a 72 pin glass-epoxy printed circuit board. 0.1μF and 0.01μF decoupling capacitors are mounted for each DRAM.
The HYM5321600AM/ATM is Tin plated and HYM5321600AMG/ATMG is Gold plated socket type Single In-line Memory Module suitable for easy interchange and addition of 64M byte memory.

FEATURES

- 72-Pin SIMM
- Fast Page Mode Operation
- */CAS-before-/RAS, /RAS-only,* Hidden and Self refresh capability
- 4096 refresh cycles / 256ms (SL-part) 4096 refresh cycles / 64ms
- Fast access time and cycle time

Speed	tRAC	tCAC	tPC
50	50ns	13ns	35ns
60	60ns	15ns	40ns
70	70ns	18ns	45ns

- TTL compatible inputs and outputs
- JEDEC standard pinout
- Single power supply of 5.0V ± 10%
- Low power dissipation

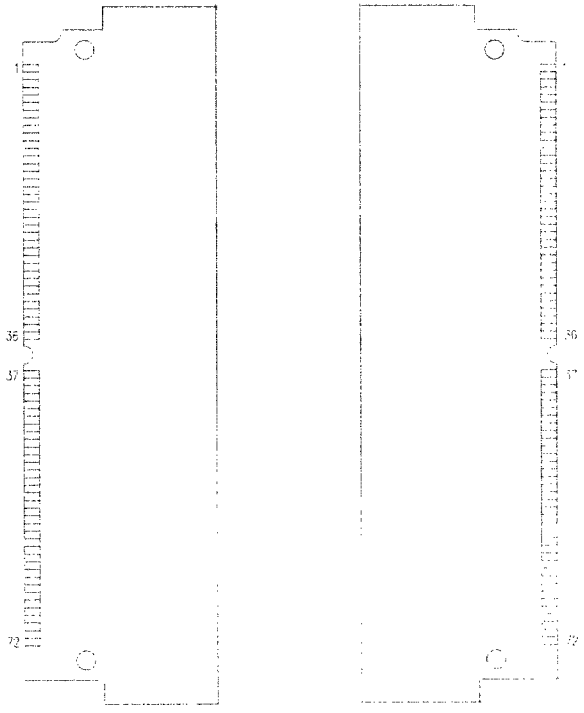
  Max. self-refresh : 52.8mW (SL-part)
  Max. battery back-up : 106mW (SL-part)
  Max. CMOS standby : 52.8mW (SL-part) 176mW
  Max. TTL standby : 352mW
  Max. operating

Speed	Power
50	19.4W
60	15.8W
70	14.1W

ORDERING INFORMATION

PART NUMBER	SPEED	FEATURES	PACKAGE	PLATING
HYM5321600AM	50/60/70	FP, 4K, 5V, SOJ	SIMM	Tin
HYM5321600AMG	50/60/70	FP, 4K, 5V, SOJ	SIMM	Gold
HYM5321600ATM	50/60/70	FP, 4K, 5V, TSOP	SIMM	Tin
HYM5321600ATMG	50/60/70	FP, 4K, 5V, TSOP	SIMM	Gold

PIN CONNECTION



PIN DISCRIPTION

/RAS0, /RAS2	Row Address Strobe
/CAS0~/CAS3	Column Address Strobe
/WE	Write Enable
A0~A11	Address Input
DQ0~DQ31	Data Input/Output
PD1~PD4	Presence Detect
VCC	Power (+5V)
VSS	Ground

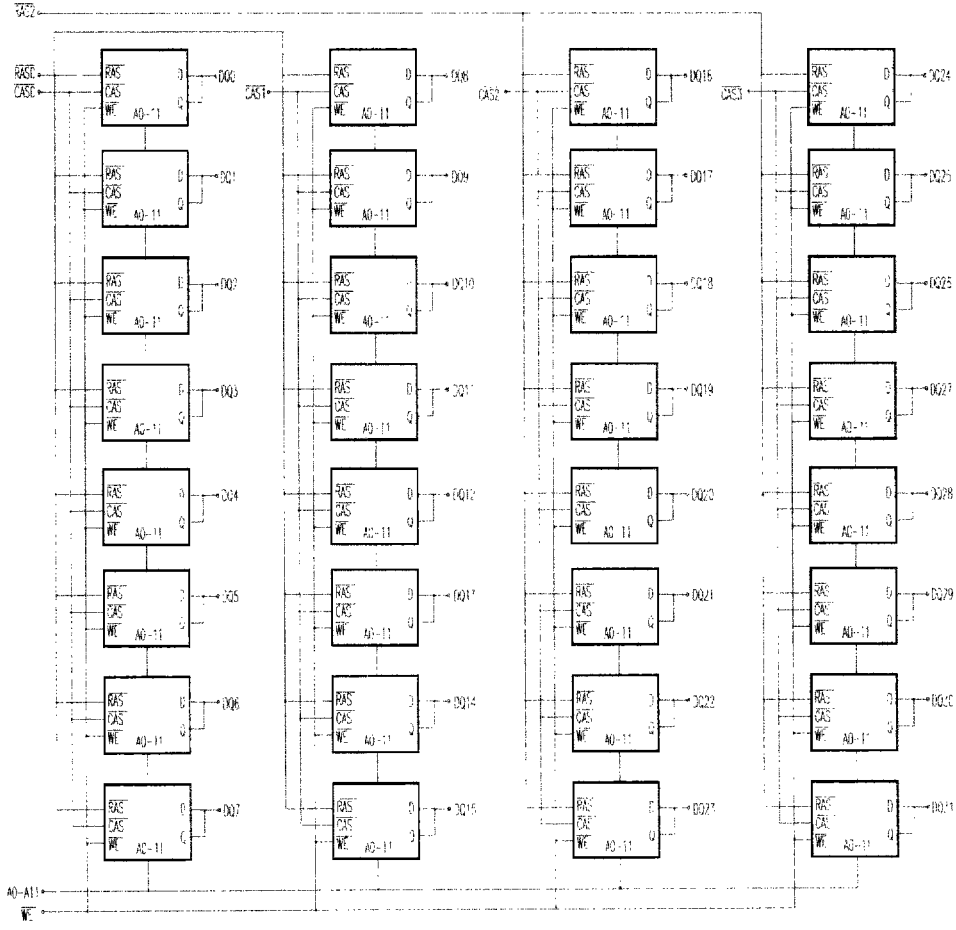
PIN ASSIGNMENTS

#	NAME	#	NAME
1	VSS	37	NC
2	DQ0	38	NC
3	DQ16	39	VSS
4	DQ1	40	/CAS0
5	DQ17	41	/CAS2
6	DQ2	42	/CAS3
7	DQ18	43	/CAS1
8	DQ3	44	/RAS0
9	DQ19	45	NC
10	VCC	46	NC
11	NC	47	/WE
12	A0	48	NC
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	A10	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	A11	65	DQ15
30	VCC	66	NC
31	A8	67	PD1
32	A9	68	PD2
33	NC	69	PD3
34	/RAS2	70	PD4
35	NC	71	NC
36	NC	72	VSS

PRESENCE DETECT PINS

Speed	PD1	PD2	PD3	PD4
50	VSS	NC	VSS	VSS
60	VSS	NC	NC	NC
70	VSS	NC	VSS	NC

BLOCK DIAGRAM



ABSOLUTE MAXIMUM RATINGS

SYMBOL	PARAMETER	RATING	UNIT
TA	Ambient Temperature	0 to 70	°C
TSTG	Storage Temperature	-55 to 150	°C
VIN, VOUT	Voltage on Any Pin relative to VSS	-1.0 to 7.0	V
VCC	Voltage on VCC relative to VSS	-1.0 to 7.0	V
IOS	Short Circuit Output Current	50	mA
PD	Power Dissipation	32	W

NOTE : Operation at or above Absolute Maximum Ratings can adversely affect device reliability.

RECOMMENDED DC OPERATING CONDITIONS

(TA=0°C to 70°C)

SYMBOL	PARAMETER	MIN.	TYP.	MAX.	UNIT
VCC	Power Supply Voltage	4.5	5.0	5.5	V
VIH	Input High Voltage	2.4	-	VCC+1.0	V
VIL	Input Low Voltage	-1.0	-	0.8	V

NOTE : All voltages are referenced to VSS.

DC CHARACTERISTICS

(T_A=0°C to 70°C, VCC=5.0V ± 10% and VSS=0V, unless otherwise noted.)

Symbol	Parameter	Test Condition	Speed/ Power	Max. Current 4K Ref	UNIT
ICC1	Operating Current	/RAS and /CAS cycling tRC=tRC (min.)	50 60 70	3520 2880 2560	mA
ICC2	TTL Standby Current	/RAS=/CAS ≥ VIH other inputs ≥ VSS		64	mA
ICC3	/RAS-only Refresh Current	/CAS=VIH, /RAS cycling tRC=tRC (min.)	50 60 70	3620 2880 2560	mA
ICC4	Fast Page Mode Current	/RAS=VIL, /CAS, Address cycling tPC=tPC (min.)	50 60 70	2560 2240 1920	mA
ICC5	CMOS Standby Current	/RAS = /CAS ≥ VCC-0.2V	 SL-part	32 9.6	mA mA
ICC6	/CAS-before-/RAS Refresh Current	/RAS and /CAS cycling tRC=tRC (min.)	50 60 70	3520 2880 2560	mA
ICC7	Battery Back-up Current (SL-part)	tRC = 62.5μs /CAS = CBR cycling or 0.2V /OE & /WE = VCC - 0.2V Address = VCC-0.2V or 0.2V DQ = VCC-0.2V, 0.2V or open	tRAS ≤ 300ns	11.2	mA
			tRAS ≤ 1μs	19.2	mA
ICC8	Self Refresh Current (SL-part)	/RAS & /CAS = 0.2V Other pins are same as ICC7		9.6	mA

Symbol	Parameter	Test condition	Min.	Max.	UNIT
ILI	Input Leakage current (Any Input)	VSS ≤ VIN ≤ VCC + 1.0 All other pins not under test = VSS	-320	320	μA
ILO	Output Leakage current (Any Input)	VSS ≤ VOUT ≤ VCC /RAS & /CAS at VIH	-10	10	μA
VOL	Output Low Voltage	IOL = 4.2mA	-	0.4	V
VOH	Output High Voltage	IOH = -5.0mA	2.4	-	V

NOTE

1. ICC1, ICC3, ICC4 and ICC6 depend on output loading and cycle rates(tRC and tPC).
2. Specified values are obtained with outputs unloaded.
3. ICC is specified as an average current. In ICC1, ICC3, ICC6, address can be changed only once while /RAS=VIL. In ICC4, address can be changed maximum once while /CAS=VIH within one Fast Page mode cycle time tPC.
4. Only /RAS(max.) = 1μs is applied to refresh of battery backup but tRAS(max.) = 10μs is applied to normal functional operation.
5. ICC5(max.) = 9.6mA, ICC7 and ICC8 are applied to SL-part only.

AC CHARACTERISTICS

(T_A=0°C to 70°C, VCC=5.0V ± 10% and VSS=0V, unless otherwise noted.)

#	SYMBOL	PARAMETER	HYM5321600A M-Series						UNIT	NOTE
			-50		-60		-70			
			MIN.	MAX.	MIN.	MAX.	MIN.	MAX.		
1	tRC	Random Read or Write Cycle Time	90	-	110	-	130	-	ns	
2	tRWC	Read-Modify-Write Cycle Time	110	-	130	-	155	-	ns	
3	tPC	Fast Page Mode Cycle Time	35	-	40	-	45	-	ns	
4	tPRWC	FP Mode Read-Modify-Write Cycle Time	55	-	60	-	70	-	ns	
5	tRAC	Access Time from /RAS	-	50	-	60	-	70	ns	4,5,6
6	tCAC	Access Time from /CAS	-	13	-	15	-	18	ns	4,5
7	tAA	Access Time from Column Address	-	25	-	30	-	35	ns	4,6
8	tCPA	Access Time from Column Precharge	-	30	-	35	-	40	ns	4,9
9	tCLZ	/CAS to Output Low Impedance	0	-	0	-	0	-	ns	4
10	tOFF	Out Buffer Turn-Off Delay Time from /CAS	0	10	0	13	0	15	ns	7
11	tT	Transition Time (Rise and Fall)	3	50	3	50	3	50	ns	2
12	tRP	/RAS Precharge Time	30	-	40	-	50	-	ns	
13	tRAS	/RAS Pulse Width	50	10K	60	10K	70	10K	ns	
14	tRASP	/RAS Pulse Width (Fast Page Mode)	50	200K	60	200K	70	200K	ns	
15	tRSH	/RAS Hold Time	13	-	15	-	18	-	ns	
16	tCSH	/CAS Hold Time	50	-	60	-	70	-	ns	
17	tCAS	/CAS Pulse Width	13	10K	15	10K	18	10K	ns	
18	tRCD	/RAS to /CAS Delay Time	18	37	20	45	20	52	ns	5
19	tRAD	/RAS to Column Address Delay Time	13	25	15	30	15	35	ns	6
20	tCRP	/CAS to /RAS Precharge Time	5	-	5	-	5	-	ns	10
21	tCP	/CAS Precharge Time	10	-	10	-	10	-	ns	
22	tASR	Row Address Set-up Time	0	-	0	-	0	-	ns	
23	tRAH	Row Address Hold Time	10	-	10	-	10	-	ns	
24	tASC	Column Address Set-up Time	0	-	0	-	0	-	ns	
25	tCAH	Column Address Hold Time	10	-	10	-	10	-	ns	
26	tRAL	Column Address to /RAS Lead Time	25	-	30	-	35	-	ns	
27	tRCS	Read Command Set-up Time	0	-	0	-	0	-	ns	
28	tRCH	Read Command Hold Time Referenced to /CAS	0	-	0	-	0	-	ns	8
29	tRRH	Read Command Hold Time Referenced to /RAS	0	-	0	-	0	-	ns	8
30	tWCH	Write Command Hold Time	8	-	10	-	10	-	ns	
31	tWP	Write Command Pulse Width	8	-	10	-	10	-	ns	
32	tRWL	Write Command to /RAS Lead Time	13	-	15	-	18	-	ns	
33	tCWL	Write Command to /CAS Lead Time	13	-	15	-	18	-	ns	

AC CHARACTERISTICS

(Continued)

#	SYMBOL	PARAMETER	HYM5321600A M-Series						UNIT	NOTE
			-50		-60		-70			
			MIN.	MAX.	MIN.	MAX.	MIN.	MAX.		
34	tDS	Data-In Set-up Time	0	-	0	-	0	-	ns	9
35	tDH	Data-In Hold Time	10	-	10	-	10	-	ns	9
36	tREF	Refresh Period (4096 cycles)	-	64	-	64	-	64	ms	
		Refresh Period (SL-part)	-	256	-	256	-	256	ms	
37	tWCS	Write Command Set-up Time	0	-	0	-	0	-	ns	10
38	tCWD	/CAS to /WE Delay Time	13	-	15	-	20	-	ns	10
39	tRWD	/RAS to /WE Delay Time	50	-	60	-	70	-	ns	10
40	tAWD	Column Address to /WE Delay Time	25	-	30	-	35	-	ns	10
41	tCSR	/CAS Set-up Time (CBR Cycle)	5	-	5	-	5	-	ns	
42	tCHR	/CAS Hold Time (CBR Cycle)	10	-	10	-	15	-	ns	
43	tRPC	/RAS to /CAS Precharge Time	5	-	5	-	5	-	ns	
44	tCPT	/CAS Precharge Time (CBR Counter Test)	15	-	20	-	25	-	ns	
45	tCPWD	/WE Delay Time from /CAS Precharge	30	-	35	-	40	-	ns	10
46	tRHCP	/RAS Hold Time from /CAS Precharge	30	-	35	-	40	-	ns	
47	tWRP	/WE to /RAS Precharge Time(CBR cycle)	10	-	10	-	10	-	ns	
48	tWRH	/WE to /RAS Hold Time (CBR cycle)	10	-	10	-	10	-	ns	
49	tRASS	/RAS Pulse Width (Self Refresh)	100	-	100	-	100	-	μs	
50	tRPS	/RAS Precharge Time (Self Refresh)	90	-	110	-	130	-	ns	
51	tCHS	/CAS Hold Time (Self Refresh)	-50	-	-50	-	-50	-	ns	

NOTE

1. An initial pause of 200μs is required after power-up followed by 8 /RAS only refresh cycles before proper device operation is achieved. In case of using internal refresh counter, a minimum of 8 CBR refresh cycles instead of 8 /RAS only refresh cycles are required.
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.)
3. The minimum specifications are used only to indicate cycle time at which proper operation over the full temperature range (TA = 0°C to 70°C) is assured.
4. Measured at VOH=2.4V and VOL=0.4V with a load equivalent to 2 TTL loads and 100pF.
5. 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 by tCAC
6. Operation within the tRCD(max.) limit insures that tRAC(max.) can be met. tRAD(max.) is specified as a reference point only. If tRAD is greater than the specified tRAD(max.) limit, then access time is controlled by tAA
7. tOFF(max.) define the time at which the output achieves the open circuit condition and is not referred to output voltage levels.
8. Either tRCH or tRRH must be satisfied for a read cycle..
9. These parameters are referred to /CAS leading edge in early write cycles and to /WE leading edge in Read-Modify-Write cycles.
10. tWCS, tRWD, tCWD, tAWD and tCPWD are not restrictive operating parameters. They are included in the data sheet as electrical characteristics only. If tWCS ≥ tWCS(min.), the cycle is an early write cycle and data out pin will remain open circuit (high impedance) through the entire cycle. If tCWD ≥ tCWD(min.), tRWD ≥ tRWD(min.) and tCPWD ≥ tCPWD(min.), then the cycle is a Read-Modify-Write cycle and data out will contain data read from the selected cell. If neither of the above conditions is satisfied, the condition of the data out is indeterminate.

CAPACITANCE

(T_A=25°C, VCC=5.0V ± 10%, VSS=0V and f = 1MHz, unless otherwise noted.)

SYMBOL	PARAMETER	TYP.	MAX.	UNIT
CIN1	Input Capacitance (A0~A11)	-	192	pF
CIN2	Input Capacitance (/RAS0, /RAS2)	-	128	pF
CIN3	Input Capacitance (/CAS0~/CAS3)	-	72	pF
CIN4	Input Capacitance (/WE)	-	256	pF
CDQ	Data Input /Output Capacitance (DQ0~DQ35)	-	22	pF

PACKAGE INFORMATION

72 pin Single In-line Memory Module (SOJ /TSOP-II Mounted)