HYM5V72A1604 F-Series

Unbuffered 16Mx72 bit CMOS DRAM MODULE
based on 8Mx8 DRAM, EDO, ECC, 4K/8K-Refresh

DESCRIPTION

The HYM5V72A1604 is a 16M x 72-bit EDO mode CMOS DRAM module consisting of eighteen 8Mx8 SOJ or TSOP and one 2048-bit EEPROM on a 168 pin glass-epoxy printed circuit board. 0.1μF and 0.01μF decoupling capacitor is mounted for each DRAM. The HYM5V72A1604F G-Series is gold plated socket type Dual In-line Memory Modules suitable for easy interchange and addition of 128M byte memory.

FEATURES

- Max. Active Power Dissipation

Speed	8K	4K
50	4.57W	6.35W
60	3.92W	5.70W
70	3.27W	5.05W

- Fast access time and cycle time

Speed	tRAC	tCAC	tHPC
50ns	50ns	13ns	20ns
60ns	60ns	15ns	25ns
70ns	70ns	20ns	30ns

- 168Pin Unbuffered DIMM
- Serial Presence Detect with EEPROM
- Extended Data Out Operation
- Single power supply of 3.3V±10%
- Read-Modify-Write Capability
- LVTTL compatible inputs and outputs
- /CAS-before-/RAS, /RAS-only, Hidden and Self Refresh Capability
- Refresh cycles

Part No.	Ref.
HYM5V72A1604 F-Series	4K
HYM5V72A1634 F-Series	8K*

* /CAS-before-/RAS refresh, Hidden refresh mode : 4K cycles / 64ms

PIN DESCRIPTION

/RAS0-/RAS3	Row Address Strobe
/CAS0-/CAS7	Column Address Strobe
/WE0, /WE2	Write Enable
/OE0, /OE2	Output Enable
A0-A12	Address Input (8K Product)
A0-A11	Address Input (4K Product)
DQ0-DQ63	Data Input/Output
CB0-CB7	Check Bit
SCL	Serial PD Clock Input
SDA	Serial PD Data Input/Output
SA0-SA2	Serial PD Address Input
VCC	Power (3.3V)
VSS	Ground

PIN NAME

#	NAME	#	NAME	#	NAME	#	NAME
1	Vss	43	Vss	85	Vss	127	Vss
2	DQ0	44	/OE2	86	DQ32	128	NC
3	DQ1	45	/RAS2	87	DQ33	129	/RAS3
4	DQ2	46	/CAS2	88	DQ34	130	/CAS6
5	DQ3	47	/CAS3	89	DQ35	131	/CAS7
6	Vcc	48	/WE2	90	Vcc	132	NC
7	DQ4	49	Vcc	91	DQ36	133	Vcc
8	DQ5	50	NC	92	DQ37	134	NC
9	DQ6	51	NC	93	DQ38	135	NC
10	DQ7	52	CB2	94	DQ39	136	CB6
11	DQ8	53	CB3	95	DQ40	137	CB7
12	Vss	54	Vss	96	Vss	138	Vss
13	DQ9	55	DQ16	97	DQ41	139	DQ48
14	DQ10	56	DQ17	98	DQ42	140	DQ49
15	DQ11	57	DQ18	99	DQ43	141	DQ50
16	DQ12	58	DQ19	100	DQ44	142	DQ51
17	DQ13	59	Vcc	101	DQ45	143	Vcc
18	Vcc	60	DQ20	102	Vcc	144	DQ52
19	DQ14	61	NC	103	DQ46	145	NC
20	DQ15	62	NC	104	DQ47	146	NC
21	CB0	63	NC	105	CB4	147	NC
22	CB1	64	Vss	106	CB5	148	Vss
23	Vss	65	DQ21	107	Vss	149	DQ53
24	NC	66	DQ22	108	NC	150	DQ54
25	NC	67	DQ23	109	NC	151	DQ55
26	Vcc	68	Vss	110	Vcc	152	Vss
27	/WE0	69	DQ24	111	NC	153	DQ56
28	/CAS0	70	DQ25	112	/CAS4	154	DQ57
29	/CAS1	71	DQ26	113	/CAS5	155	DQ58
30	/RAS0	72	DQ27	114	/RAS1	156	DQ59
31	/OE0	73	Vcc	115	NC	157	Vcc
32	Vss	74	DQ28	116	Vss	158	DQ60
33	A0	75	DQ29	117	A1	159	DQ61
34	A2	76	DQ30	118	A3	160	DQ62
35	A4	77	DQ31	119	A5	161	DQ63
36	A6	78	Vss	120	A7	162	Vss
37	A8	79	NC	121	A9	163	NC
38	A10	80	NC	122	A11	164	NC
39	*A12	81	NC	123	NC	165	SA0
40	Vcc	82	SDA	124	Vcc	166	SA1
41	Vcc	83	SCL	125	NC	167	SA2
42	NC	84	Vcc	126	NC	168	Vcc

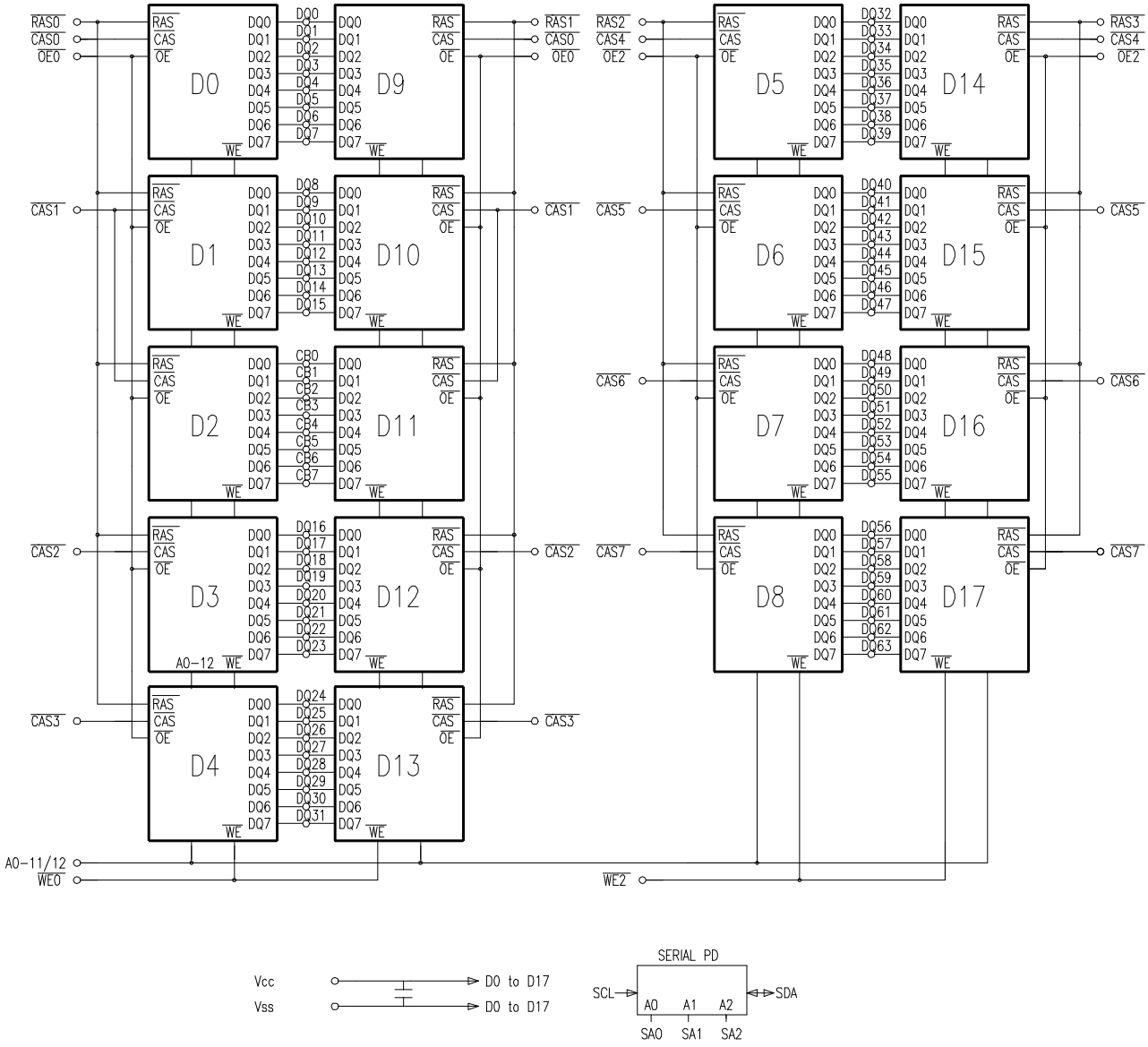
NOTE :
1.A12 is used for 8K-Refresh Product (HYM5V72A1634 F-Series)

SERIAL PRESENCE DETECT

BYTE NUMBER	FUNCTION DESCRIBED	FUNCTION		VALUE
BYTE0	# of Byte Written into Serial Memory at Module Manufacturer	128 Bytes		80h
BYTE1	Total # of Bytes of SPD Memory Device	256 Bytes		08h
BYTE2	Fundamental Memory Type	EDO		02h
BYTE3	# of Row Addresses on This Assembly	12(4K Ref) 13(8K Ref)		0Ch 0Dh
BYTE4	# of Column Addresses on This Assembly	11(4K Ref) 10(8K Ref)		0Bh 0Ah
BYTE5	# of Module Banks on This Assembly	2 Bank		02h
BYTE6	Data Width of This Assembly	72 Bits		48h
BYTE7	Data Width of This Assembly(Continued)	-		00h
BYTE8	Voltage Interface Standard of This Assembly	LVTTL		01h
BYTE9	tRAC	50ns 60ns 70ns		32h 3Ch 46h
BYTE10	tCAC	13ns 15ns 20ns		0Dh 0Fh 14h
BYTE11	DIMM Configuration Type	ECC		02h
BYTE12	Refresh Rate/Type	4K/8K Ref, Normal(15.6µs)		00h
BYTE13	Primary DRAM Width	x8		08h
BYTE14	Error Checking DRAM Width	x8		08h
BYTE15-61	Undefined	Undefined		FFh
BYTE62	SPD Data Revision Code	Initial		00h
BYTE63	Checksum for Byte 0-62	4K/8K Ref. Normal(15.6µs)	50ns 60ns 70ns	0Eh 1Ah 29h
BYTE64-125	Manufacturer Data Field	HYUNDAI MFD		-
BYTE126-127	Reserved	Reserved		FFh
BYTE128-255	Undefined	Undefinded		FFh

NOTE :
1.Serial PD interface is standard IIC architecture.
2.Pull-up resistors(4.7K typical value) are required on all open collector bus devices(SCL and SDA).
3.Current sink capability on SCL and SDA (Iol max) must be at least 3mA to maintain a valid low level.
4.Checksum can be obtained by adding the binary values in Byte 0-62, and eliminate all but low order byte. The low order byte would be the `Checksum`.
5.Refer to HYUNDAI Manufacturer Data SPEC for Byte 64-125.

BLOCK DIAGRAM



NOTE :
1.A12 is used for 8K-Refresh Product (HYM5V72A1634 F-Series)

ABSOLUTE MAXIMUM RATINGS

SYMBOL	PARAMETER	RATING	UNIT
T_A	Ambient Temperature	0 to 70	°C
T_{STG}	Storage Temperature	-55 to 150	°C
V_{IN}, V_{OUT}	Voltage on Any Pin relative to V_{SS}	-0.5 to 4.6	V
V_{CC}	Voltage on V_{CC} relative to V_{SS}	-0.5 to 4.6	V
I_{OS}	Short Circuit Output Current	50	mA
P_D	Power Dissipation	18	W
T_{SOLDER}	Soldering Temperature•Time	260•10	°C•sec

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

RECOMMENDED DC OPERATING CONDITIONS

(T_A=0°C to 70°C)

SYMBOL	PARAMETER	MIN.	TYP.	MAX.	UNIT
V_{CC}	Power Supply Voltage	3.0	3.3	3.6	V
V_{IH}	Input High Voltage	2.0	-	V_{CC}+0.3	V
V_{IL}	Input Low Voltage	-0.3	-	0.8	V

Note: All voltages are referenced to V_{SS}.

DC CHARACTERISTICS

(T_A=0°C to 70°C , V_{CC}=3.3V ± 10%, V_{SS}=0V, unless otherwise noted.)

Symbol	Parameter	Test Conditions	Speed	Max. Current		Unit
				8K Product	4K Product	
I_{CC1}	Operating Current	/RAS, /CAS Cycling tRC=tRC (min.)	50 60 70	1269 1089 909	1764 1584 1404	mA
I_{CC2}	LVTTL Standby Current	/RAS = /CAS ≥ V_{IH} other inputs ≥ V_{SS}		18	18	mA
I_{CC3}	/RAS-only Refresh Current	/RAS cycling /CAS = V_{IH} tRC = tRC (min.)	50 60 70	1224 1044 864	1584 1404 1224	mA
I_{CC4}	EDO Mode Current	/CAS cycling /RAS = V_{IL} tHPC = tHPC (min.)	50 60 70	1224 1044 864	1404 1224 1044	mA
I_{CC5}	CMOS Standby Current	/RAS = /CAS ≥ V_{CC} - 0.2V	 SL-part	9 5.4	9 5.4	mA
I_{CC6}	/CAS-before-/RAS Refresh Current	tRC=tRC (min.)	50 60 70	1584 1404 1224	1584 1404 1224	mA
I_{CC7}	Battery Back-up Current (SL-part)	V_{IH} = V_{CC} - 0.2V, V_{IL} = 0.2V /CAS = CBR cycling or 0.2V /OE & /WE = V_{IH} = V_{CC} - 0.2V Address = Don`t care DQs & CBs = Open		12.6	12.6	mA
I_{CC8}	Self Refresh Current (SL-part)	/RAS & /CAS = 0.2V Other pins are same as I_{CC7}		12.6	12.6	mA

Symbol	Parameter	Test Condition	Min.	Max	Unit
I_{LI}	Input Leakage current(Any Input)	V_{SS} ≤ V_{IN} ≤ V_{CC} + 0.3, All other pins not under test=V_{SS}	-18	18	µA
I_{LO}	Output Leakage current(Any Input)	V_{SS} ≤ V_{OUT} ≤ V_{CC} /RAS & /CAS at V_{IH}	-2	2	µA
V_{OL}	Output Low Voltage	I_{OL} = 2.0mA	-	0.4	V
V_{OH}	Output High Voltage	I_{OH} = -2.0mA	2.4	-	V

NOTE

1. I_{CC1}, I_{CC3}, I_{CC4} and I_{CC6} dependent on output loading and cycle rates(tRC and tHPC).
2. Specified values are obtained with outputs unloaded.
3. I_{CC} is specified as an average current. In I_{CC}1, I_{CC}3, I_{CC}6, address can be changed only once while /RAS=VIL. In I_{CC}4, address can be changed maximum once while /CAS=V_{IH} within one EDO mode cycle time tHPC.
4. Only /RAS(max.) = 1µs is applied to refresh of battery backup but tRAS(max.) = 10µs is applied to normal functional operation.
5. I_{CC}5(max.) = 5.4mA, I_{CC}7 and I_{CC}8 are applied to SL-part only.
6. V_{OH} = 2.0V, V_{OL} = 0.8V at AC Functional Test.

AC CHARACTERISTICS

(T_A=0°C to 70°C , Vcc=3.3V ± 10%, Vss=0V, unless otherwise noted.)

#	SYMBOL	PARAMETER	HYH5V72A1604 / HYM5V72A1634						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	120	-	140	-	170	-	ns	
3	tHPC	EDO Mode Cycle Time	20	-	25	-	30	-	ns	
4	tHPRWC	EDO Mode Read-Modify-Write Cycle Time	50	-	60	-	75	-	ns	
5	tRAC	Access Time from /RAS	-	50	-	60	-	70	ns	4,5,10,11
6	tCAC	Access Time from /CAS	-	13	-	15	-	20	ns	4,5,10
7	tAA	Access Time from Column Address	-	25	-	30	-	35	ns	4,5,11
8	tCPA	Access Time from /CAS Precharge	-	30	-	35	-	40	ns	4
9	tCLZ	/CAS to Output Low Impedance	0	-	0	-	0	-	ns	3
10	tCEZ	Output Buffer Turn-off delay from /CAS	0	10	0	15	0	15	ns	
11	tT	Transition Time (Rise and Fall)	2	50	2	50	2	50	ns	4
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 (EDO Mode)	50	100K	60	100K	70	100K	ns	
15	tRSH	/RAS Hold Time	15	-	15	-	20	-	ns	
16	tCSH	/CAS Hold Time	45	-	55	-	65	-	ns	
17	tCAS	/CAS Pulse Width	8	10K	10	10K	15	10K	ns	
18	tRCD	/RAS to /CAS Delay	15	37	20	45	20	50	ns	10
19	tRAD	/RAS to Column Address Delay Time	10	25	15	30	15	35	ns	11
20	tCRP	/CAS to /RAS Precharge Time	5	-	5	-	5	-	ns	
21	tCP	/CAS Precharge Time	7	-	10	-	10	-	ns	
22	tASR	Row Address Set-up Time	0	-	0	-	0	-	ns	
23	tRAH	Row Address Hold Time	8	-	10	-	10	-	ns	
24	tASC	Column Address Set-up Time	0	-	0	-	0	-	ns	
25	tCAH	Column Address Hold Time	8	-	10	-	15	-	ns	
26	tAR	Column Address Hold Time from /RAS	45	-	50	-	55	-	ns	
27	tRAL	Column Address to /RAS Lead Time	25	-	30	-	35	-	ns	
28	tRCS	Read Command Set-up Time	0	-	0	-	0	-	ns	
29	tRCH	Read Command Hold Time Referenced to /CAS	0	-	0	-	0	-	ns	7
30	tRRH	Read Command Hold Time Referenced to /RAS	0	-	0	-	0	-	ns	7
31	tWCH	Write Command Hold Time	10	-	10	-	10	-	ns	
32	tWCR	Write Command Hold Time from /RAS	40	-	45	-	50	-	ns	
33	tWP	Write Command Pulse Width	10	-	10	-	10	-	ns	
34	tRWL	Write Command to /RAS Lead Time	15	-	15	-	20	-	ns	
35	tCWL	Write Command to /CAS Lead Time	8	-	10	-	15	-	ns	

AC CHARACTERISTICS

(Continued)

#	SYMBOL	PARAMETER	HYM5V72A1604 / HYM5V72A1634						UNIT	NOTE
			-50		-60		-70			
			MIN.	MAX.	MIN.	MAX.	MIN.	MAX.		
36	tDS	Data-In Set-up Time	0	-	0	-	0	-	ns	8
37	tDH	Data-In Hold Time	10	-	10	-	10	-	ns	8
38	tDHR	Data-In Hold Time Referenced to /RAS	40	-	45	-	50	-	ns	
39	tREF	Refresh Period (8192 cycles)	-	64	-	64	-	64	ms	12,13
		Refresh Period (4096 cycles)	-	64	-	64	-	64	ms	12
		Refresh Period (SL-part)	-	256	-	256	-	256	ms	12,13
40	tWCS	Write Command Set-up Time	0	-	0	-	0	-	ns	9
41	tCWD	/CAS to /WE Delay Time	34	-	36	-	45	-	ns	9
42	tRWD	/RAS to /WE Delay Time	70	-	80	-	95	-	ns	9
43	tAWD	Column Address to /WE Delay Time	45	-	50	-	60	-	ns	9
44	tCSR	/CAS Set-up Time (CBR Cycle)	5	-	5	-	5	-	ns	
45	tCHR	/CAS Hold Time (CBR Cycle)	10	-	10	-	10	-	ns	
46	tRPC	/RAS to /CAS Precharge Time	5	-	5	-	5	-	ns	
47	tCPT	/CAS Precharge Time (CBR Counter Test)	25	-	30	-	35	-	ns	
48	tROH	/RAS Hold Time Referenced to /OE	0	-	0	-	0	-	ns	
49	tOEA	/OE Access Time	-	13	-	15	-	20	ns	
50	tOED	/OE to Data Delay	13	-	15	-	20	-	ns	
51	tOEZ	Output Buffer Turn-Off Delay Time from /OE	0	10	0	15	0	15	ns	6
52	tOEH	/OE Command Hold Time	13	-	15	-	20	-	ns	
53	tCPWD	/WE Delay Time from /CAS Precharge	45	-	54	-	64	-	ns	9
54	tRHCP	/RAS Hold Time from /CAS Precharge	30	-	35	-	40	-	ns	
55	tWRP	/WE to /RAS Precharge Time(CBR cycle)	10	-	10	-	10	-	ns	
56	tWRH	/WE to /RAS Hold Time (CBR cycle)	10	-	10	-	10	-	ns	
57	tWTS	Write Command Set-up Time (Test Mode In)	10	-	10	-	10	-	ns	
58	tWTH	Write Command Hold Time (Test Mode In)	10	-	10	-	10	-	ns	
59	tRASS	/RAS Pulse Width (Self Refresh)	100K	-	100K	-	100K	-	us	
60	tRPS	/RAS Precharge Time (Self Refresh)	100	-	100	-	100	-	ns	
61	tCHS	/CAS Hold Time (Self Refresh)	-50	-	-50	-	-50	-	ns	
62	tDOH	Output Data Hold Time	5	-	5	-	5	-	ns	
63	tREZ	Output Buffer Turn-off Delay from /RAS	0	10	0	15	0	15	ns	6
64	tWEZ	Output Buffer Turn-off Delay from /WE	0	10	0	15	0	15	ns	6
65	tWED	/WE to Data Delay Time	15	-	15	-	15	-	ns	
66	tOEP	/OE Precharge Time	5	-	5	-	5	-	ns	
67	tWPE	/WE Pulse Width (EDO cycle)	5	-	5	-	5	-	ns	
68	tOCH	/OE to /CAS Hold Time	5	-	5	-	5	-	ns	
69	tCHO	/CAS Hold Time to /OE	5	-	5	-	5	-	ns	

NOTE

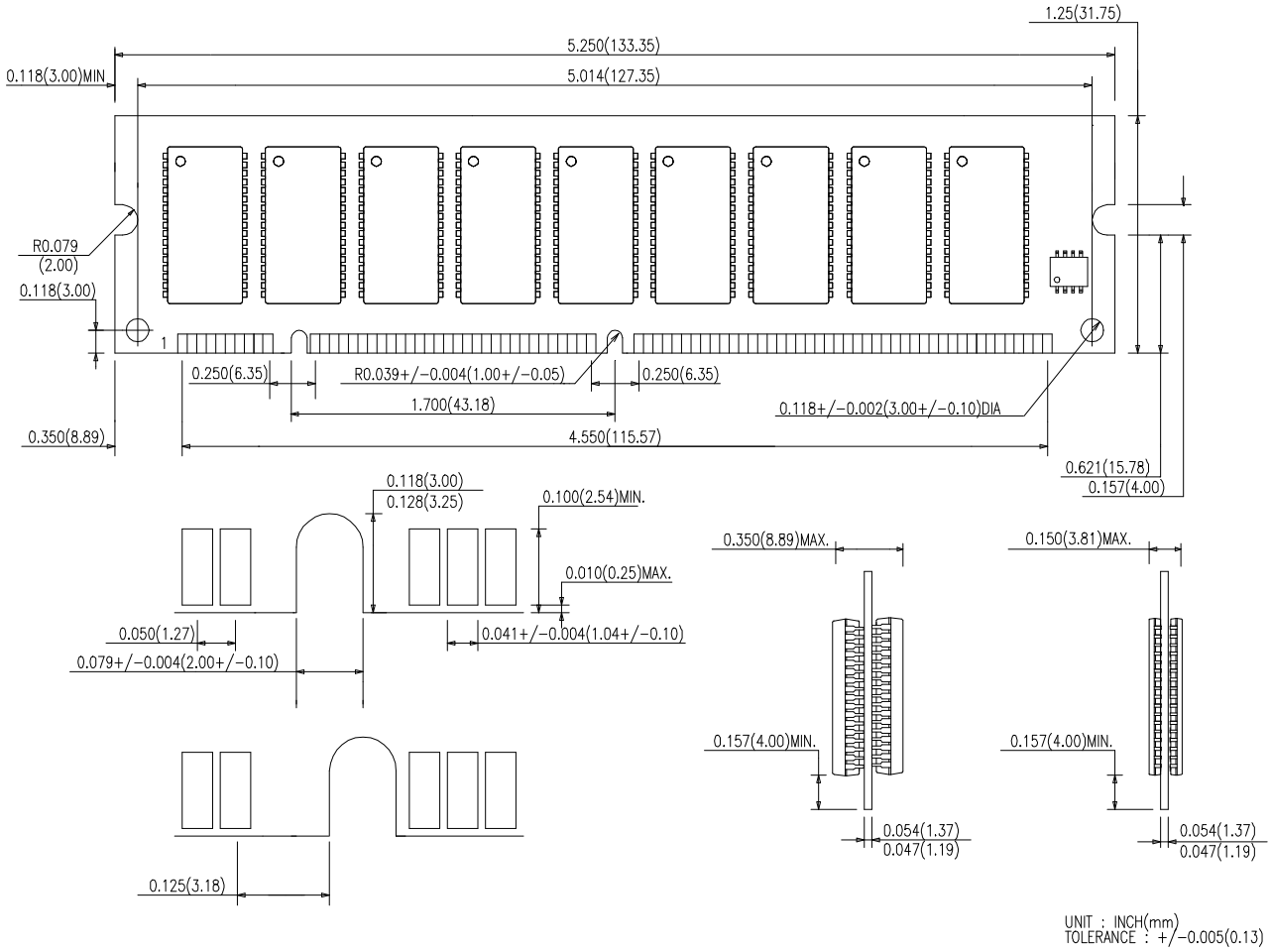
1. An initial pause of 200μs is required after power-up followed by 8 /RAS cycles before proper device operation is achieved. In case of using internal refresh counter, a minimum of 8 /CAS-before-/RAS initialization cycles instead of 8 /RAS-only refresh cycles are required. The device should be carefully initialized to be prevented from being entered into multi bit test mode during initialization.
2. If /RAS=Vss during power-up, the HYM5V72A1604 / HYM5V72A1634 could begin an active cycle. This condition results in higher current than necessary current which is demanded from the power supply during power-up.
3. It is recommended that /RAS and /CAS track with Vcc during power-up or be held at a valid V_{IH} in order to minimize the power-up current.
4. 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.
5. Measured at V_{OH}=2.0V and V_{OL}=0.8V with a load equivalent to 1 TTL loads and 100pF.
6. tWEZ, tREZ, tCEZ and tOEZ define the time at which the output achieves the open circuit condition and is not referenced to output voltage levels.
7. Either tRCH or tRRH must be satisfied for a read cycle.
8. These parameters are referenced to /CAS leading edge in early write cycles and to /WE leading edge in Read-Modify-Write cycles and late Write cycle.
9. 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 tRWD ≥ tRWD(min.), tCWD ≥ tCWD(min.), tAWD ≥ tAWD(min.), and tCPWD ≥ tCPWD(min.), the cycle is a Read-Modify-Write cycle and data out will contain data read from the selected cell. If neither of the above sets of conditions is satisfied, the condition of the data out (at access time) is indeterminate.
10. Operation within the tRCD(max.) limit ensures 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.
11. Operation within the tRAD(max.) limit ensures 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.
12. tREF(max.)=256ms is applied to SL-parts.
13. A burst of 8192 /CAS-before-/RAS refresh cycles must be executed within 64ms (256ms for SL-parts) after exiting self refresh. (CBR refresh & Hidden refresh : 4K cycle/64ms)

CAPACITANCE

(T_A=0°C to 70°C , Vcc=3.3V ± 10%, Vss=0V, f = 1MHz, unless otherwise noted.)

SYMBOL	PARAMETER	TYP.	MAX.	UNIT
C_{IN1}	Input Capacitance (A0 - A12)	-	110	pF
C_{IN2}	Input Capacitance (/WE0, /WE2, /OE0, /OE2)	-	83	pF
C_{IN3}	Input Capacitance (/RAS0 - /RAS3)	-	45	pF
C_{IN4}	Input Capacitance (/CAS0 - /CAS7)	-	32	pF
C_{DQ}	Data Input /Output Capacitance (DQs, CBs)	-	18	pF

PACKAGE INFORMATION



ORDERING INFORMATION

Part Number	Ref.	Power	Package
HYM5V72A1604FG	4K	Normal	SOJ
HYM5V72A1604TFG	4K	Normal	TSOP
HYM5V72A1634FG	8K	Normal	SOJ
HYM5V72A1634TFG	8K	Normal	TSOP