

### DESCRIPTION

This family is a 4M bit dynamic RAM organized 131,072 x 16-bit configuration with CMOS DRAMs. The circuit and process design allow this device to achieve high performance and low power dissipation. In dependant read and write of upper and lower byte is controlled by 2 separate /CAS inputs. Optional features are access time(50, 60 or 70ns), package type(SOJ, TSOP-II), and power onsumption (Normal or Low power with self refresh). Hyundai's advanced circuit design and process technology allow this device to achieve high bandwidth, low power consumption and high reliability.

### FEATURES

- Extended data out operation
- Read-modify-write Capability
- 2/CAS inputs for upper and lower byte control
- TTL compatible inputs and outputs
- /CAS-before-/RAS, /RAS-only, Hidden and Self refresh capability
- Max. Active power dissipation
- JEDEC standard pinout
- 40-pin Plastic SOJ (400mil)  
40/44-pin plastic TSOP-II (400mil)
- Single power supply of 5V ± 10%
- Early Write or output enable controlled write
- Fast access time and cycle time

Speed	Power
50	605mW
60	550mW
70	495mW

Speed	tRAC	tCAC	tHPC
50	50ns	15ns	20ns
60	60ns	17ns	24ns
70	70ns	20ns	29ns

- Refresh cycle

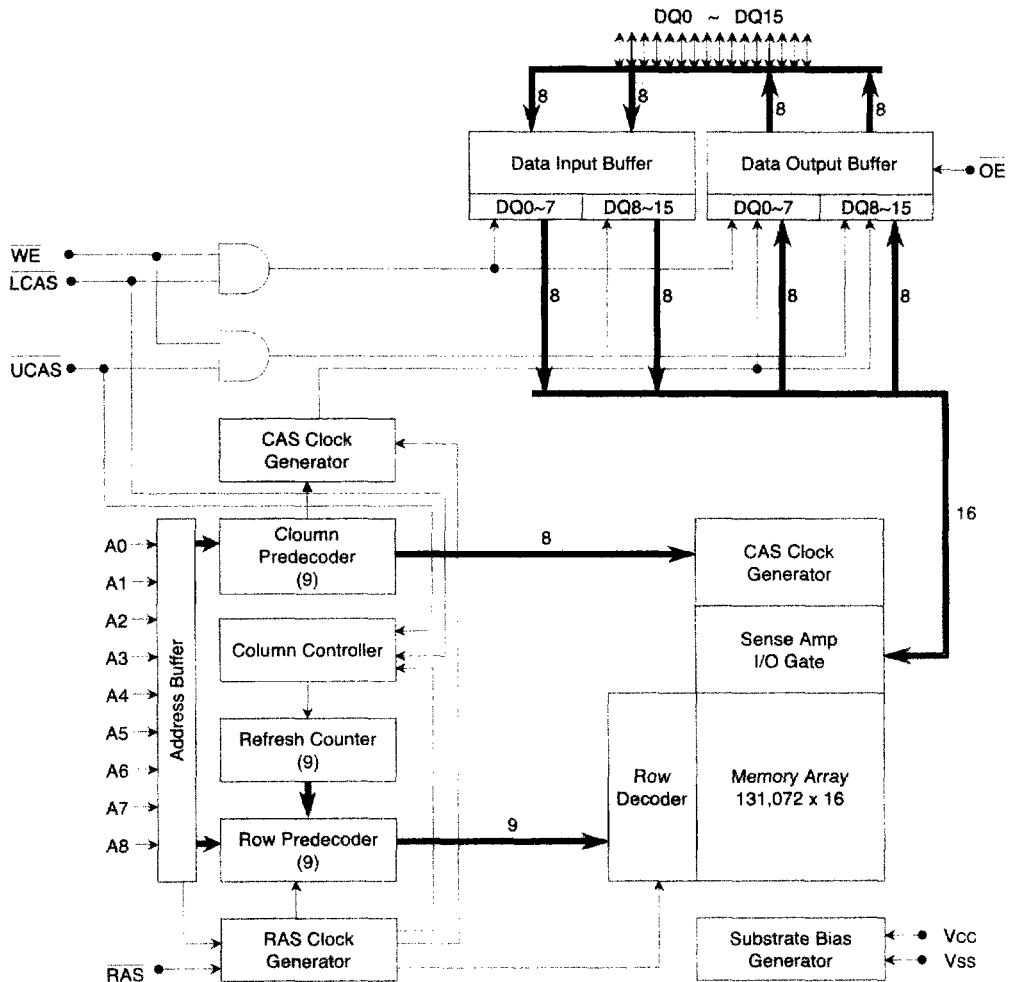
Part number	Refresh	Normal	SL-part
HY512264	512	8ms	128ms

### ORDERING INFORMATION

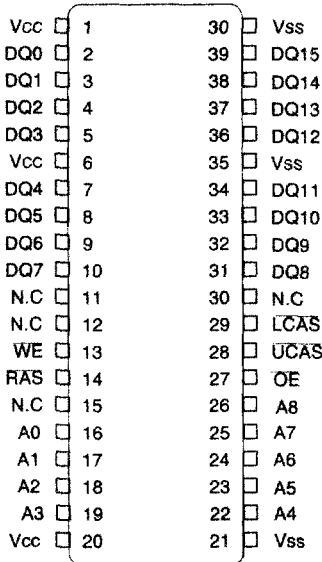
Part Name	Refresh	Power	Package
HY512264JC	512		40Pin SOJ
HY512264LJC	512	L-part	40Pin SOJ
HY512264SLJC	512	SL-part	40Pin SOJ
HY512264TC	512		40/44Pin TSOP-II
HY512264LTC	512	L-part	40/44Pin TSOP-II
HY512264SLTC	512	SL-part	40/44Pin TSOP-II

\*SL : Low power with self refresh

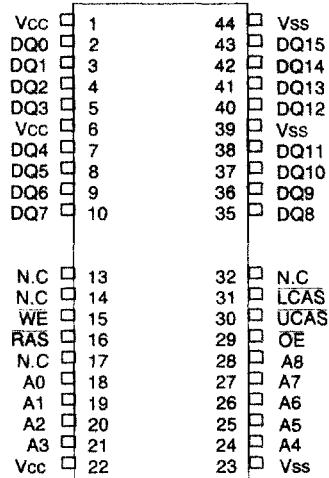
**FUNCTIONAL BLOCK DIAGRAM**



PIN CONFIGURATION (Marking Side)



40Pin Plastic SOJ (400mil)



40/44Pin Plastic TSOP- II (400mil)

PIN DESCRIPTION

Pin Name	Parameter
/RAS	Row Address Strobe
/CAS	Column Address Strobe
/WE	Write Enable
/OE	Output Enable
A0~A8	Address Input
DQ0~DQ15	Data In/Out
Vcc	Power (5V)
Vss	Ground

## ABSOLUTE MAXIMUM RATING

Symbol	Parameter	Rating	Unit
T <sub>A</sub>	Ambient Temperature	0 to 70	°C
T <sub>STG</sub>	Storage Temperature	-55 to 150	°C
V <sub>IN</sub> , V <sub>OUT</sub>	Voltage on Any Pin relative to V <sub>SS</sub>	-1.0 to 7.0	V
V <sub>CC</sub>	Voltage on V <sub>CC</sub> relative to V <sub>SS</sub>	-1.0 to 7.0	V
I <sub>OS</sub>	Short Circuit Output Current	50	mA
P <sub>D</sub>	Power Dissipation	1	W
T <sub>SOLDER</sub>	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<sub>A</sub> = 0°C to 70°C)

Symbol	Parameter	Min	Typ	Max	UNIT
V <sub>CC</sub>	Power Supply Voltage	4.5	5.0	5.5	V
V <sub>IH</sub>	Input High Voltage	2.4	-	V <sub>CC</sub> +1.0	V
V <sub>IL</sub>	Input Low Voltage	-1.0	-	0.8	V

Note : All voltages are referenced to V<sub>SS</sub>.

## DC OPERATING CHARACTERISTIC

Symbol	Parameter	Test condition	Min	Max	Unit
I <sub>LI</sub>	Input Leakage Current (Any input)	V <sub>SS</sub> ≤ V <sub>IN</sub> ≤ V <sub>CC</sub> + 1.0 All other pins not under test = V <sub>SS</sub>	-10	10	μA
I <sub>LO</sub>	Output Leakage Current (Any input)	V <sub>SS</sub> ≤ V <sub>OUT</sub> ≤ V <sub>CC</sub> /RAS & /CAS at V <sub>IH</sub>	-10	10	μA
V <sub>OL</sub>	Output Low Voltage	I <sub>OL</sub> = 4.2mA	-	0.4	V
V <sub>OH</sub>	Output High Voltage	I <sub>OH</sub> = -5.0mA	2.4	-	V

## DC CHARACTERISTICS

(TA = 0°C to 70°C, VCC = 5V ± 10%, VSS = 0V, unless otherwise noted.)

Symbol	Parameter	Test condition	Speed	Max.	Unit
Icc1	Operating Current	/RAS, /CAS Cycling TRC = tRC(min.)	50 60 70	110 100 90	mA
Icc2	TTL Standby Current	/RAS, /CAS ≥ VIH(min) Other inputs ≥ VSS		2	mA
Icc3	/RAS-only Refresh Current	/RAS Cycling, /CAS = VIH TRC = tRC(min.)	50 60 70	110 100 90	mA
Icc4	EDO mode Current	/CAS Cycling, /RAS = VIL tHPC = tHPC(min.)	50 60 70	100 100 90	mA
Icc5	CMOS Standby Current	/RAS = /CAS ≥ VCC - 0.2V	L-part	1 200	mA μA
Icc6	/CAS-before-/RAS Refresh Current	/RAS & /CAS = 0.2V TRC = tRC(min.)	50 60 70	100 110 100	mA
Icc7	Battery Back-up Current (SL-part)	tRC=125μs /CAS = CBR cycling or 0.2V /OE & /WE = VCC - 0.2V Address = VCC-0.2V or 0.2V DQ0~DQ15 = VCC-0.2, 0.2V or Open	tRAS ≤ 1μs	400	μA
Icc8	Self Refresh Current (SL-part)	/RAS & /CAS = 0.2V Other pins are same as Icc7		400	μA

## Note

- Icc1, Icc3, Icc4, Icc6 and Icc7 depend on output loading and cycle rates (TRC and tHPC).
- Specified values are obtained with output unloaded.
- 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 Extended Data Out mode cycle time tPC.
- Only tRAS(max) = 1μs is applied to refresh of battery backup but tRAS(max) = 10μs is to applied to normal functional operation.
- Icc5(max.), Icc7 and Icc8 are applied to SL-part only.
- Operating condition for 50ns part is VCC=5V ± 5%, Cout 30pF.

## AC CHARACTERISTICS

(TA = 0 °C to 70 °C, Vcc = 5V ± 10%, Vss = 0V, unless otherwise noted.)

Symbol	Parameter	50ns		60ns		70ns		Unit	Note
		Min	Max	Min	Max	Min	Max		
tRC	Random read or write cycle time	84	-	104	-	124	-	ns	
trWC	Read-modify-write cycle time	120	-	140	-	170	-	ns	
tHPC	Extended Data Out mode cycle time	20	-	24	-	29	-	ns	
tHPRWC	EDO mode read-modify-write cycle time	61	-	68	-	83	-	ns	
tRAC	Access time from /RAS	-	50	-	60	-	70	ns	4,9,10
tCAC	Access time from /CAS	-	15	-	17	-	20	ns	4,9
tAA	Access time from column address	-	25	-	30	-	35	ns	4,10
tCPA	Access time from /CAS precharge	-	30	-	35	-	40	ns	4,15
tCLZ	/CAS to output low impedance	0	-	0	-	0	-	ns	4
tr	Transition time(rise and fall)	2	50	2	50	2	50	ns	3
tRP	/RAS precharge time	30	-	40	-	50	-	ns	
tRAS	/RAS pulse width	50	10K	60	10K	70	10K	ns	
tRASP	/RAS pulse width(EDO mode)	50	100K	60	100K	70	100K	ns	
tRSH	/RAS hold time	15	-	15	-	20	-	ns	
tCSH	/CAS hold time	45	-	55	-	65	-	ns	
tCAS	/CAS pulse width	8	10K	10	10K	15	10K	ns	
tRCD	/RAS to /CAS delay time	15	37	20	45	20	50	ns	9
tRAD	/RAS to column address delay time	10	25	15	30	15	35	ns	10
tCRP	/CAS to /RAS precharge time	5	-	5	-	5	-	ns	
tCP	/CAS precharge time	8	-	10	-	10	-	ns	
tASR	Row address set-up time	0	-	0	-	0	-	ns	
tRAH	Row address hold time	8	-	10	-	10	-	ns	
tASC	Column address set-up time	0	-	0	-	0	-	ns	14
tCAH	Column address hold time	8	-	10	-	15	-	ns	
tAR	Column address hold time from /CAS	45	-	50	-	55	-	ns	
tRAL	Column address to /RAS lead time	25	-	30	-	35	-	ns	
tRCS	Read command set-up time	0	-	0	-	0	-	ns	
tRCH	Read command hold time referenced to /CAS	0	-	0	-	0	-	ns	6
tRRH	Read command hold time referenced to /RAS	0	-	0	-	0	-	ns	6
tWCH	Write command hold time	10	-	10	-	10	-	ns	
tWCR	Write command hold time from /RAS	40	-	50	-	55	-	ns	
tWP	Write command pulse width	10	-	10	-	10	-	ns	
tRWL	Write command to /RAS lead time	15	-	15	-	20	-	ns	

## AC CHARACTERISTICS

Continued

Symbol	Parameter	50ns		60ns		70ns		Unit	Note
		Min	Max	Min	Max	Min	Max		
tCWL	Write command to /CAS lead time	8	-	10	-	15	-	ns	
tDS	Data-in set-up time	0	-	0	-	0	-	ns	7
tDH	Data-in hold time	10	-	10	-	15	-	ns	7
tDHR	Data-in hold time Referenced to /RAS	40	-	50	-	55	-	ns	
tREF	Refresh period(512 cycles)	-	8	-	8	-	8	ms	11
	Refresh period(SL-part)	-	128	-	128	-	128	ms	8
tWCS	Write command set-up time	0	-	0	-	0	-	ns	8
tCWD	/CAS to /WE delay time	34	-	36	-	44	-	ns	8
tRWD	/RAS to /WE delay time	69	-	79	-	94	-	ns	8
tAWD	Column address to /WE delay time	44	-	49	-	59	-	ns	8
tCSR	/CAS set-up time(CBR cycle)	5	-	5	-	5	-	ns	
tCHR	/CAS hold time(CBR cycle)	10	-	10	-	10	-	ns	
tRPC	/RAS to /CAS precharge time	5	-	5	-	5	-	ns	
tCPT	/CAS precharge time(CBR counter test)	25	-	30	-	35	-	ns	
tROH	/RAS hold time referenced to /OE	0	-	0	-	0	-	ns	
tOEA	/OE access time	-	15	-	15	-	20	ns	
tOED	/OE to data delay	15	-	15	-	20	-	ns	
tO EZ	Output buffer turn-off delay time from /OE	0	15	0	15	0	20	ns	5
tOEH	/OE command hold time	15	-	15	-	20	-	ns	
tCPWD	/WE delay time from /CAS precharge	49	-	54	-	64	-	ns	8
tRHCP	/RAS hold time from /CAS precharge	30	-	35	-	40	-	ns	
tRASS	/RAS pulse width(self refresh)	100	-	100	-	100	-	ns	
tRPS	/RAS Precharge Time (Self refresh)	100	-	100	-	100	-	ns	
tCHS	/CAS Hold Time (Self refresh)	-50	-	-50	-	-50	-	ns	
tOCH	/OE to /CAS Hold Time	0	-	0	-	0	-	ns	
tCHO	/CAS Precharge to /OE Precharge time	10	-	10	-	10	-	ns	
tOEP	/OE Pulse width	10	-	10	-	10	-	ns	
tREZ	Output Buffer Turn-off Delay from /RAS	0	15	0	15	0	15	ns	
tWEZ	Output Buffer Turn-off Delay from /WE	0	15	0	15	0	15	ns	
tCEZ	Output Buffer Turn-off Delay from /CAS	0	15	0	15	0	15	ns	

## NOTE

1. An initial pause of 200 $\mu$ s 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. If /RAS=Vss during power-up, the HY512264 could begin an active cycle. This condition results in higher current than necessary current which is demanded from the power supply during power-up. It is recommended that /RAS and /CAS track with Vcc during power-up or be held at a valid VIH in other to minimize the power-up current.
3. 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 2ns for all inputs.
4. Measured at VOH=2.0V and VOL=0.8V with a load equivalent to 2TTL loads and 30pF.
5. tCEZ(max.) and tOEZ define the time at which the output achieves the open circuit conditions and is not referenced to output voltage levels.
6. Either tRCD or tRRH must be satisfied for a read cycle.
7. These parameters are referenced to /LCAS or /UCAS leading edge in early write cycles and to /WE leading edge in read-modify-write cycles
8. twCS, tRWD, tCWD, tAWD and tCPWD are not restrictive operating parameters. They are included in the data sheet as electrical characteristics only. If twCS  $\geq$  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  $\geq$  tRWD(min.), tCWD  $\geq$  tCWD(min.), tAWD  $\geq$  tAWD(min), and tCPWD  $\geq$  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.
9. 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.
10. 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.
11. tREF(max.)=128ms is aren;t to L-parts and SL-parts.
12. A burst of 512 CBR refresh cycles must be executed within 8ms (128ms for SL-part) after exiting self refresh.
13. When both /LCAS and /UCAS go low at the same time, all 16-bits data are written into the device. /LCAS and /UCAS must be transited simultaneously withen a same read or write cycle.
14. These parameters are determined by the earlier falling edge of /LCAS and /UCAS.
15. These parameters are determined by the later rising edge of /LCAS or /UCAS.
16. tCWL must be satisfied by both /LCAS and /UCAS for 16-bits access cycles.
17. tCP and tCPT are measured when both /LCAS and /UCAS are high state.
18. Operating condition for 50ns part is Vcc=5V $\pm$ 5%, Cout=30pF.

## CAPACITANCE

(TA = 25°C, VCC = 5V  $\pm$  10%, VSS = 0V and f=1MHz, unless otherwise noted.)

Symbol	Parameter	Typ.	Max	Unit
CIN1	Input Capacitance (A0~A8)	-	5	pF
CIN2	Input Capacitance (/RAS, /LCAS, /UCAS, /WE, /OE)	-	7	pF
CDQ	Data Input / Output Capacitance (DQ0~DQ15)	-	7	pF