

DESCRIPTION

This family is a 4M bit dynamic RAM organized 1,048,576 x 4-bit configuration with Extended Data Out mode CMOS DRAMs. Extended data out mode is a kind of page mode which is useful for the read operation. The circuit and process design allow this device to achieve high performance and low power dissipation. Optional features are access time(50, 60 or 70ns) and package type(SOJ, TSOP-II) and power consumption (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
- TTL compatible inputs and outputs
- /CAS-before-/RAS, /RAS-only, Hidden and Self refresh capability
- Max. Active power dissipation
- JEDEC standard pinout
- 20/26-pin SOJ (300mil)
20/26-pin TSOP-II (300mil)
- Single power supply of $5V \pm 10\%$
- Early Write or output enable controlled write
- Fast access time and cycle time

Speed	Power
50	550mW
60	495mW
70	440mW

Speed	tRAC	tCAC	tHPC
50	50ns	13ns	20ns
60	60ns	15ns	25ns
70	70ns	18ns	30ns

- Refresh cycle

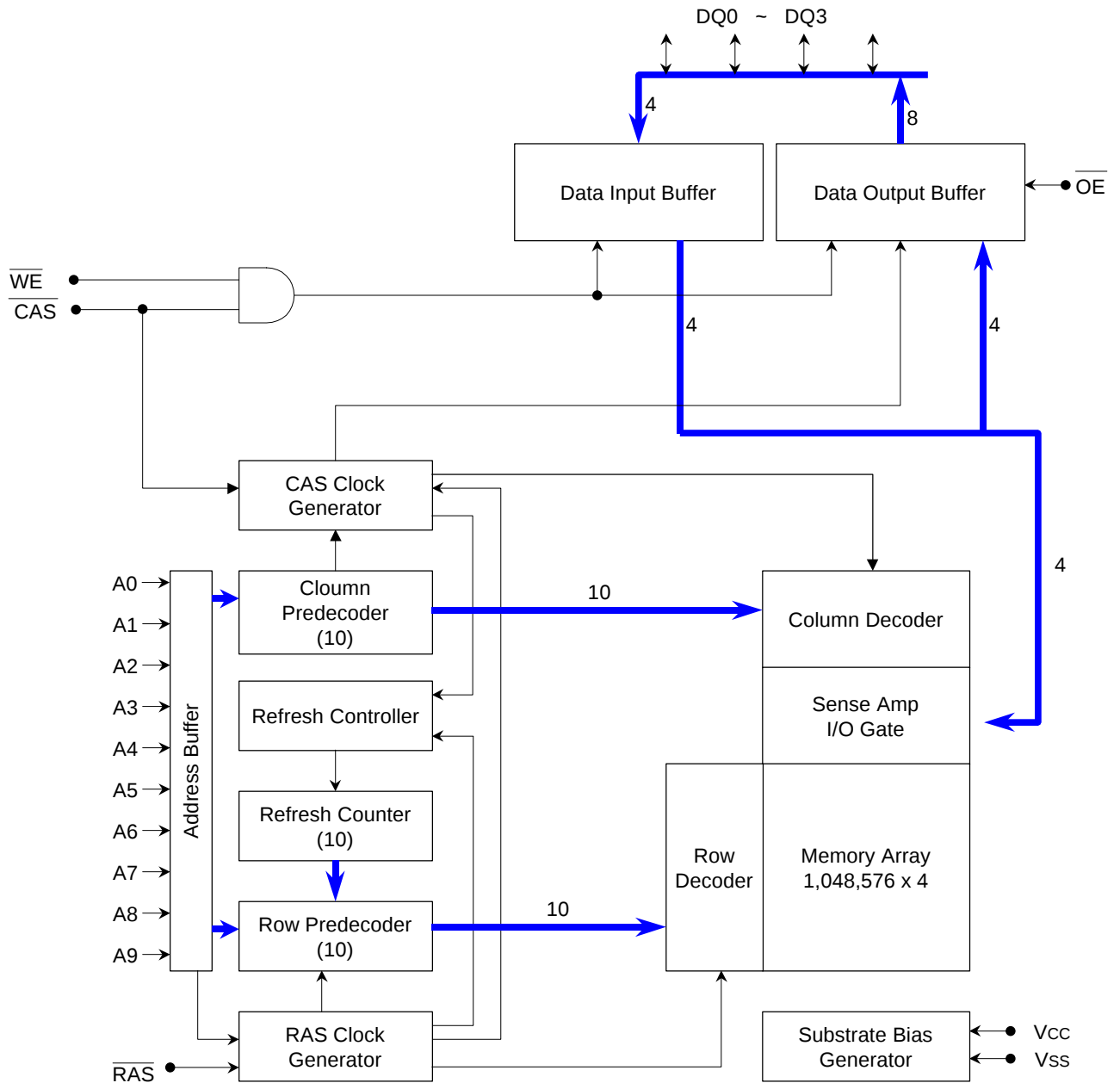
Part number	Refresh	Normal	SL-part
HY514404B	1K	16ms	128ms

ORDERING INFORMATION

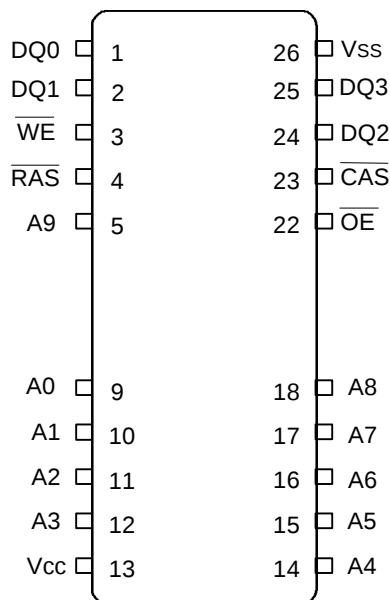
Part Name	Refresh	Power	Package
HY514404BJ	1K		20/26Pin SOJ
HY514404BLJ	1K	L-part	20/26Pin SOJ
HY514404BSLJ	1K	SL-part	20/26Pin SOJ
HY514404BT	1K		20/26Pin TSOP-II
HY514404BLT	1K	L-part	20/26Pin TSOP-II
HY514404BSLT	1K	SL-part	20/26Pin TSOP-II

*SL : Low power with self refresh

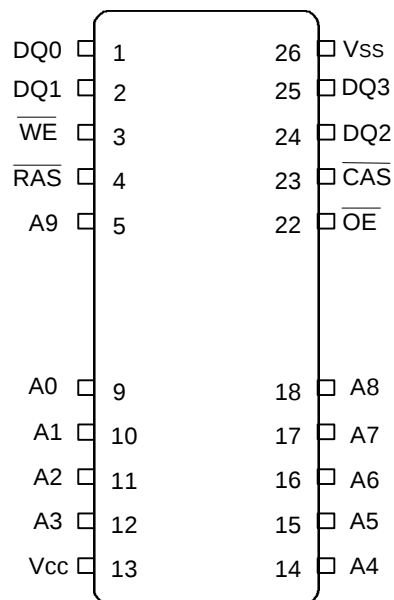
FUNCTIONAL BLOCK DIAGRAM



PIN CONFIGURATION (Marking Side)



20/26 Pin Plastic SOJ (300mil)



20/26 Pin Plastic TSOP- II (300mil)

PIN DESCRIPTION

Pin Name	Parameter
/RAS	Row Address Strobe
/CAS	Column Address Strobe
/WE	Write Enable
/OE	Output Enable
A0~A9	Address Input
DQ0~DQ3	Data In/Out
Vcc	Power (5V)
Vss	Ground

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}	-1.0 to 7.0	V
V _{CC}	Voltage on V _{CC} relative to V _{SS}	-1.0 to 7.0	V
I _{OS}	Short Circuit Output Current	50	mA
P _D	Power Dissipation	0.9	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	4.5	5.0	5.5	V
V _{IH}	Input High Voltage	2.4	-	V _{CC} +1.0	V
V _{IL}	Input Low Voltage	-1.0	-	0.8	V

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

DC OPERATING CHARACTERISTICS

Symbol	Parameter	Test condition	Min	Max	Unit
I _{LI}	Input Leakage Current (Any input)	V _{SS} ≤ V _{IN} ≤ V _{CC} + 1.0 All other pins not under test = V _{SS}	-10	10	μA
I _{LO}	Output Leakage Current (Any input)	V _{SS} ≤ V _{OUT} ≤ V _{CC} /RAS & /CAS at V _{IH}	-10	10	μA
V _{OL}	Output Low Voltage	I _{OL} = 4.2mA	-	0.4	V
V _{OH}	Output High Voltage	I _{OH} = -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	100 90 80	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	100 90 80	mA
Icc4	EDO mode Current	/CAS Cycling, /RAS = VIL tHPC = tHPC(min)	50 60 70	100 90 80	mA
Icc5	CMOS Standby Current	/RAS = /CAS ≥ VCC - 0.2V	SL-part	1 200	mA μA
Icc6	/CAS-before-/RAS Refresh Current	/RAS & /CAS = 0.2V tRC = tRC(min.)	50 60 70	100 90 80	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~DQ3 = VCC-0.2, 0.2V or Open	tRAS ≤ 300ns	300	μA
			tRAS ≤ 1μs	400	
Icc8	Self Refresh Current (SL-part)	/RAS & /CAS = 0.2V Other pins are same as Icc7		300	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 EDO mode cycle time tHPC.
- 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.

AC CHARACTERISTICS

(T_A = 0 °C to 70 °C, V_{CC} = 5V ± 10% , V_{SS} = 0V, unless otherwise noted.)

Symbol	Parameter	50ns		60ns		70ns		Unit	Note
		Min	Max	Min	Max	Min	Max		
t _{RC}	Random read or write cycle time	84	-	104	-	124	-	ns	
t _{RWC}	Read-modify-write cycle time	113	-	137	-	160	-	ns	
t _{HPC}	EDO mode cycle time	20	-	25	-	30	-	ns	
t _{HPRW}	EDO mode read-modify-write cycle time	61	-	70	-	78	-	ns	
t _{RAC}	Access time from /RAS	-	50	-	60	-	70	ns	4,9,10
t _{CAC}	Access time from /CAS	-	13	-	15	-	18	ns	4,9
t _{AA}	Access time from column address	-	25	-	30	-	35	ns	4,10
t _{CPA}	Access time from /CAS precharge	-	30	-	35	-	40	ns	4,15
t _{CLZ}	/CAS to output low impedance	3	-	3	-	3	-	ns	4
t _T	Transition time(rise and fall)	2	50	2	50	2	50	ns	3
t _{RP}	/RAS precharge time	30	-	40	-	50	-	ns	
t _{RAS}	/RAS pulse width	50	10K	60	10K	70	10K	ns	
t _{RASP}	/RAS pulse width(EDO mode)	50	200K	60	200K	70	200K	ns	
t _{RSH}	/RAS hold time	13	-	15	-	18	-	ns	
t _{CSH}	/CAS hold time	40	-	50	-	60	-	ns	
t _{CAS}	/CAS pulse width	8	10K	11	10K	14	10K	ns	
t _{RCD}	/RAS to /CAS delay time	18	37	20	45	20	52	ns	9
t _{RAD}	/RAS to column address delay time	10	25	15	30	15	35	ns	10
t _{CRP}	/CAS to /RAS precharge time	5	-	5	-	5	-	ns	15
t _{CP}	/CAS precharge time	8	-	10	-	12	-	ns	17
t _{ASR}	Row address set-up time	0	-	0	-	0	-	ns	
t _{RAH}	Row address hold time	10	-	10	-	10	-	ns	
t _{ASC}	Column address set-up time	0	-	0	-	0	-	ns	14
t _{CAH}	Column address hold time	10	-	10	-	10	-	ns	14
t _{AR}	Column address hold time from /CAS	50	-	50	-	50	-	ns	
t _{RAL}	Column address to /RAS lead time	25	-	30	-	35	-	ns	
t _{RCS}	Read command set-up time	0	-	0	-	0	-	ns	14
t _{RCH}	Read command hold time referenced to /CAS	0	-	0	-	0	-	ns	6,14
t _{RRH}	Read command hold time referenced to /RAS	0	-	0	-	0	-	ns	6
t _{WCH}	Write command hold time	8	-	10	-	10	-	ns	14
t _{WCR}	Write command hold time from /RAS	40	-	50	-	55	-	ns	
t _{WP}	Write command pulse width	8	-	10	-	10	-	ns	
t _{RWL}	Write command to /RAS lead time	10	-	12	-	12	-	ns	

AC CHARACTERISTICS

Continued

Symbol	Parameter	50ns		60ns		70ns		Unit	Note
		Min	Max	Min	Max	Min	Max		
tcWL	Write command to /CAS lead time	10	-	12	-	12	-	ns	16
tDS	Data-in set-up time	0	-	0	-	0	-	ns	7
tDH	Data-in hold time	10	-	10	-	10	-	ns	7
tDHR	Data-in hold time Referenced to /RAS	50	-	50	-	50	-	ns	
tREF	Refresh period(1024 cycles)	16	-	16	-	16	-	ms	12
	Refresh period(SL-part)	128	-	128	-	128	-	ms	11
twCS	Write command set-up time	0	-	0	-	0	-	ns	8,14
tcWD	/CAS to /WE delay time	30	-	34	-	40	-	ns	8
trWD	/RAS to /WE delay time	67	-	79	-	92	-	ns	8
tAWD	Column address to /WE delay time	42	-	49	-	57	-	ns	8
tCSR	/CAS set-up time(CBR cycle)	5	-	5	-	5	-	ns	14
tCHR	/CAS hold time(CBR cycle)	10	-	10	-	10	-	ns	15
trPC	/RAS to /CAS precharge time	5	-	5	-	5	-	ns	14
tcPT	/CAS precharge time(CBR counter test)	15	-	20	-	25	-	ns	17
tROH	/RAS hold time referenced to /OE	10	-	10	-	10	-	ns	
toEA	/OE access time	-	13	-	15	-	18	ns	
toED	/OE to data delay	13	-	15	-	18	-	ns	
toEZ	Output buffer turn-off delay time from /OE	3	13	3	15	3	18	ns	5
toEH	/OE command hold time	13	-	15	-	18	-	ns	
tcpWD	/WE delay time from /CAS precharge	47	-	54	-	62	-	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)	90	-	110	-	130	-	ns	
tCHS	/CAS Hold Time (Self refresh)	-50	-	-50	-	-50	-	ns	
tDOH	Output Data Hold Time	5	-	5	-	5	-	ns	
treZ	Output Buffer Turn Off Delay Time from /RAS	3	13	5	15	5	18	ns	
twEZ	Output Buffer Turn Off Delay Time from /WE	3	13	5	15	5	18	ns	
toEP	/OE Pulse Width	5	-	5	-	8	-	ns	
toCH	/OE to /CAS Hold Time	0	-	0	-	0	-	ns	
tCHO	/CAS Hold Time to /OE	5	-	5	-	8	-	ns	
toEP	/OE Pulse Width	5	-	5	-	8	-	ns	
tCEZ	Output Buffer Turn-off Delay from /CAS	3	13	3	15	3	18	ns	

NOTE

1. An initial pause of 200 μ 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 HY514404B 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 order 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 5ns for all inputs.
4. Measured at VOH=2.0V and VOL=0.8V with a load equivalent to 2TTL loads and 100pF.
5. tOFF(max.) and tOEZ define the time at which the output achieves the open circuit condition and is not referenced to output voltage levels.
6. Either tRCH or tRRH must be satisfied for a read cycle.
7. tCEZ and tOEZ define the time at which the output achieves the open circuit condition and is not referenced to output voltage levels.
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 applied to SL-parts only.
12. A burst of 1024 CBR refresh cycles must be executed within 16ms (128ms for SL-part) after exiting self refresh.
13. When CAS goes low at the same time, 4bits data are written into the device.
14. These parameters are determined by the earlier falling edge of /CAS.
15. These parameters are determined by the later rising edge of /CAS.
16. tCWL must be satisfied by /CAS for 4bits access cycle.
17. tCP and tCPT are measured when /CAS and is high state.

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~A9)	-	5	pF
CIN2	Input Capacitance (/RAS, /CAS, /WE, /OE)	-	7	pF
CDQ	Data Input / Output Capacitance (DQ0~DQ3)	-	7	pF