

Document Title

**1Mx4 Bit High Speed Static RAM(5V Operating).
Operated at Extended and Industrial Temperature Ranges.**

Revision History

RevNo.	History	Draft Data	Remark
Rev. 0.0	Initial release with Preliminary.	Feb. 12. 1999	Preliminary
Rev. 1.0	1.1 Removed Low power Version. 1.2 Removed Data Retention Characteristics 1.3 Changed I _{SB1} to 20mA	Mar. 29. 1999	Preliminary
Rev. 2.0	2.1 Relax D.C parameters.	Aug. 19. 1999	Preliminary

Item		Previous	Current
I _{CC}	12ns	160mA	190mA
	15ns	155mA	185mA
	20ns	150mA	180mA

2.2 Relax Absolute Maximum Rating.

Item	Previous	Current
Voltage on Any Pin Relative to V _{SS}	-0.5 to 7.0	-0.5 to V _{CC} +0.5

Rev. 3.0	3.1 Delete Preliminary 3.2 Update D.C parameters and 10ns part.	Mar. 27. 2000	Final
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	Previous			Current		
	I _{CC}	I _{SB}	I _{SB1}	I _{CC}	I _{SB}	I _{SB1}
10ns	-	70mA	20mA	160mA	60mA	10mA
12ns	190mA			150mA		
15ns	185mA			140mA		
20ns	180mA			130mA		

3.3 Added Extended temperature range

The attached data sheets are prepared and approved by SAMSUNG Electronics. SAMSUNG Electronics CO., LTD. reserve the right to change the specifications. SAMSUNG Electronics will evaluate and reply to your requests and questions on the parameters of this device. If you have any questions, please contact the SAMSUNG branch office near your office, call or contact Headquarters.

1M x 4 Bit (with OE) High-Speed CMOS Static RAM

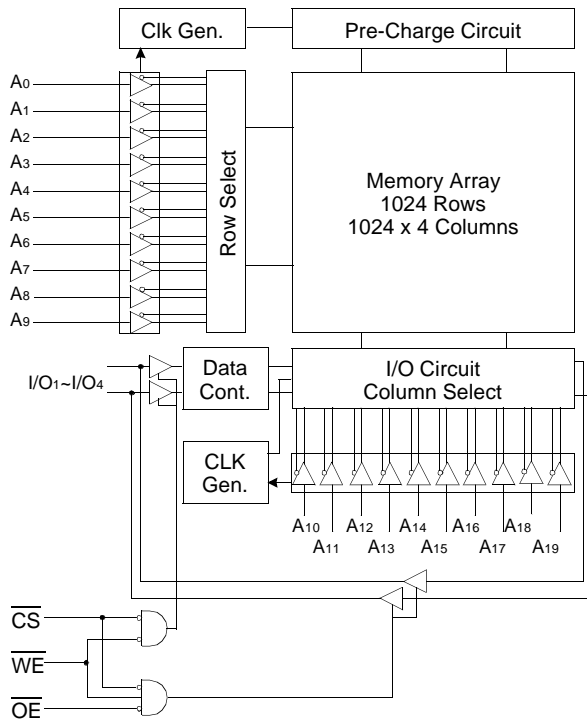
FEATURES

- Fast Access Time 10,12,15,20ns(Max.)
- Low Power Dissipation
 - Standby (TTL) : 60mA(Max.)
 - (CMOS) : 10mA(Max.)
 - Operating K6R4004C1C-10 : 160mA(Max.)
 - K6R4004C1C-12 : 150mA(Max.)
 - K6R4004C1C-15 : 140mA(Max.)
 - K6R4004C1C-20 : 130mA(Max.)
- Single 5.0V ±10% Power Supply
- TTL Compatible Inputs and Outputs
- I/O Compatible with 3.3V Device
- Fully Static Operation
 - No Clock or Refresh required
- Three State Outputs
- Center Power/Ground Pin Configuration
- Standard Pin Configuration
 - K6R4004C1C-J : 32-SOJ-400

ORDERING INFORMATION

K6R4004C1C-C10/C12/C15/C20	Commercial Temp.
K6R4004C1C-E10/E12/E15/E20	Extended Temp.
K6R4004C1C-I10/I12/I15/I20	Industrial Temp.

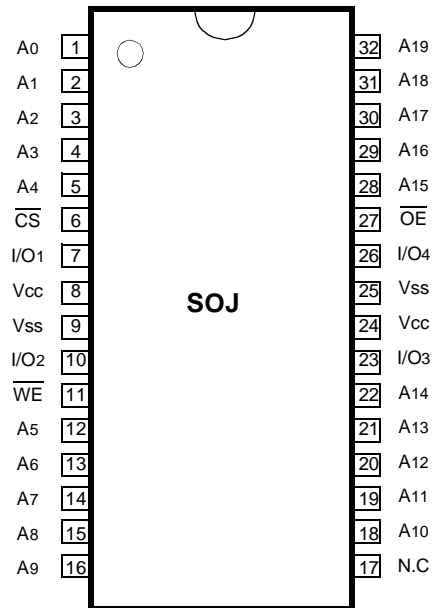
FUNCTIONAL BLOCK DIAGRAM



GENERAL DESCRIPTION

The K6R4004C1C is a 4,194,304-bit high-speed Static Random Access Memory organized as 1,048,576 words by 4 bits. The K6R4004C1C uses 4 common input and output lines and has an output enable pin which operates faster than address access time at read cycle. The device is fabricated using SAM-SUNG's advanced CMOS process and designed for high-speed circuit technology. It is particularly well suited for use in high-density high-speed system applications. The K6R4004C1C is packaged in a 400 mil 32-pin plastic SOJ.

PIN CONFIGURATION (Top View)



PIN FUNCTION

Pin Name	Pin Function
A0 - A19	Address Inputs
\overline{WE}	Write Enable
\overline{CS}	Chip Select
\overline{OE}	Output Enable
I/O1 ~ I/O4	Data Inputs/Outputs
Vcc	Power(+5.0V)
Vss	Ground
N.C	No Connection

ABSOLUTE MAXIMUM RATINGS*

Parameter		Symbol	Rating	Unit
Voltage on Any Pin Relative to Vss		V _{IN} , V _{OUT}	-0.5 to V _{CC} +0.5	V
Voltage on Vcc Supply Relative to Vss		V _{CC}	-0.5 to 7.0	V
Power Dissipation		P _D	1.0	W
Storage Temperature		T _{STG}	-65 to 150	°C
Operating Temperature	Commercial	T _A	0 to 70	°C
	Extended	T _A	-25 to 85	°C
	Industrial	T _A	-40 to 85	°C

* Stresses greater than those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operating sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect reliability.

RECOMMENDED DC OPERATING CONDITIONS*(T_A=0 to 70°C)

Parameter	Symbol	Min	Typ	Max	Unit
Supply Voltage	V _{CC}	4.5	5.0	5.5	V
Ground	V _{SS}	0	0	0	V
Input High Voltage	V _{IH}	2.2	-	V _{CC} +0.5***	V
Input Low Voltage	V _{IL}	-0.5**	-	0.8	V

* The above parameters are also guaranteed at extended and industrial temperature range.

** V_{IL}(Min) = -2.0V a.c(Pulse Width ≤ 8ns) for I ≤ 20mA.

*** V_{IH}(Max) = V_{CC} + 2.0V a.c (Pulse Width ≤ 8ns) for I ≤ 20mA.

DC AND OPERATING CHARACTERISTICS*(T_A=0 to 70°C, V_{CC}=5.0V±10%, unless otherwise specified)

Parameter	Symbol	Test Conditions	Min	Max	Unit			
Input Leakage Current	I _{LI}	V _{IN} =V _{SS} to V _{CC}	-2	2	μA			
Output Leakage Current	I _{LO}	$\overline{CS}=V_{IH}$ or $\overline{OE}=V_{IH}$ or $\overline{WE}=V_{IL}$ V _{OUT} =V _{SS} to V _{CC}	-2	2	μA			
Operating Current	I _{CC}	Min. Cycle, 100% Duty $\overline{CS}=V_{IL}$, V _{IN} =V _{IH} or V _{IL} , I _{OUT} =0mA	Com.	10ns	-	160	mA	
				12ns	-	150		
				15ns	-	140		
				20ns	-	130		
				Ext. Ind.	10ns	-		175
					12ns	-		165
					15ns	-		155
					20ns	-		145
Standby Current	I _{SB}	Min. Cycle, $\overline{CS}=V_{IH}$	-	60	mA			
	I _{SB1}	f=0MHz, $\overline{CS} \geq V_{CC}-0.2V$, V _{IN} ≥ V _{CC} -0.2V or V _{IN} ≤ 0.2V	-	10				
Output Low Voltage Level	V _{OL}	I _{OL} =8mA	-	0.4	V			
Output High Voltage Level	V _{OH}	I _{OH} =-4mA	2.4	-	V			
	V _{OH1} **	I _{OH1} =-0.1mA	-	3.95	V			

* The above parameters are also guaranteed at extended and industrial temperature range.

** V_{CC}=5.0V±5%, Temp.=25°C.

CAPACITANCE*(T_A=25°C, f=1.0MHz)

Item	Symbol	Test Conditions	MIN	Max	Unit
Input/Output Capacitance	C _{I/O}	V _{I/O} =0V	-	8	pF
Input Capacitance	C _{IN}	V _{IN} =0V	-	7	pF

* Capacitance is sampled and not 100% tested.

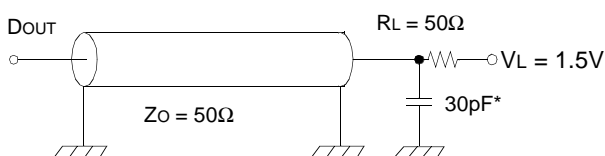
AC CHARACTERISTICS (TA=0 to 70°C, VCC=5.0V±10%, unless otherwise noted.)

TEST CONDITIONS*

Parameter	Value
Input Pulse Levels	0V to 3V
Input Rise and Fall Times	3ns
Input and Output timing Reference Levels	1.5V
Output Loads	See below

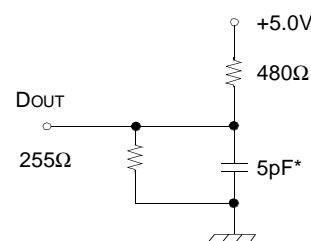
* The above test conditions are also applied at extended and industrial temperature range.

Output Loads(A)



Output Loads(B)

for tHZ, tLZ, tWHZ, tOW, tOLZ & tOHZ



* Capacitive Load consists of all components of the test environment.

* Including Scope and Jig Capacitance

READ CYCLE*

Parameter	Symbol	K6R4004C1C-10		K6R4004C1C-12		K6R4004C1C-15		K6R4004C1C-20		Unit
		Min	Max	Min	Max	Min	Max	Min	Max	
Read Cycle Time	tRC	10	-	12	-	15	-	20	-	ns
Address Access Time	tAA	-	10	-	12	-	15	-	20	ns
Chip Select to Output	tCO	-	10	-	12	-	15	-	20	ns
Output Enable to Valid Output	tOE	-	5	-	6	-	7	-	8	ns
Chip Enable to Low-Z Output	tLZ	3	-	3	-	3	-	3	-	ns
Output Enable to Low-Z Output	tOLZ	0	-	0	-	0	-	0	-	ns
Chip Disable to High-Z Output	tHZ	0	5	0	6	0	7	0	9	ns
Output Disable to High-Z Output	tOHZ	0	5	0	6	0	7	0	9	ns
Output Hold from Address Change	tOH	3	-	3	-	3	-	3	-	ns
Chip Selection to Power Up Time	tPU	0	-	0	-	0	-	0	-	ns
Chip Selection to Power Down Time	tPD	-	10	-	12	-	15	-	20	ns

* The above parameters are also guaranteed at extended and industrial temperature range.

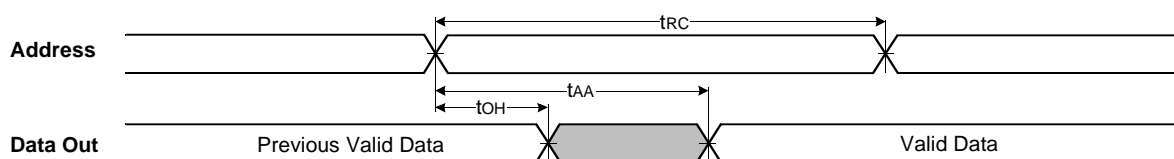
WRITE CYCLE*

Parameter	Symbol	K6R4004C1C-10		K6R4004C1C-12		K6R4004C1C-15		K6R4004C1C-20		Unit
		Min	Max	Min	Max	Min	Max	Min	Max	
Write Cycle Time	tWC	10	-	12	-	15	-	20	-	ns
Chip Select to End of Write	tCW	7	-	8	-	10	-	12	-	ns
Address Set-up Time	tAS	0	-	0	-	0	-	0	-	ns
Address Valid to End of Write	tAW	7	-	8	-	10	-	12	-	ns
Write Pulse Width(\overline{OE} High)	tWP	7	-	8	-	10	-	12	-	ns
Write Pulse Width(\overline{OE} Low)	tWP1	10	-	12	-	15	-	20	-	ns
Write Recovery Time	tWR	0	-	0	-	0	-	0	-	ns
Write to Output High-Z	tWHZ	0	5	0	6	0	7	0	9	ns
Data to Write Time Overlap	tDW	5	-	6	-	7	-	9	-	ns
Data Hold from Write Time	tDH	0	-	0	-	0	-	0	-	ns
End Write to Output Low-Z	tOW	3	-	3	-	3	-	3	-	ns

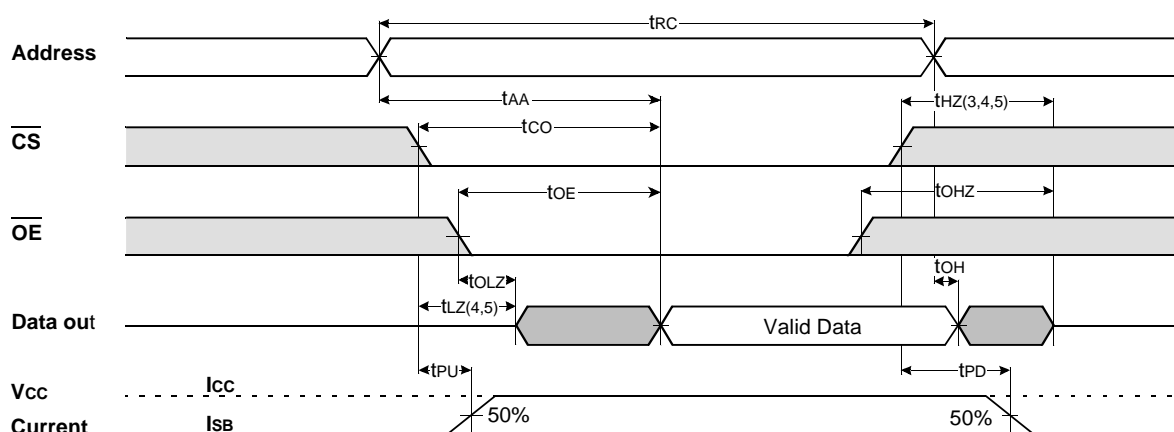
* The above parameters are also guaranteed at extended and industrial temperature range.

TIMMING DIAGRAMS

TIMING WAVEFORM OF READ CYCLE(1) (Address Controlled, $\overline{CS}=\overline{OE}=V_{IL}$, $\overline{WE}=V_{IH}$)



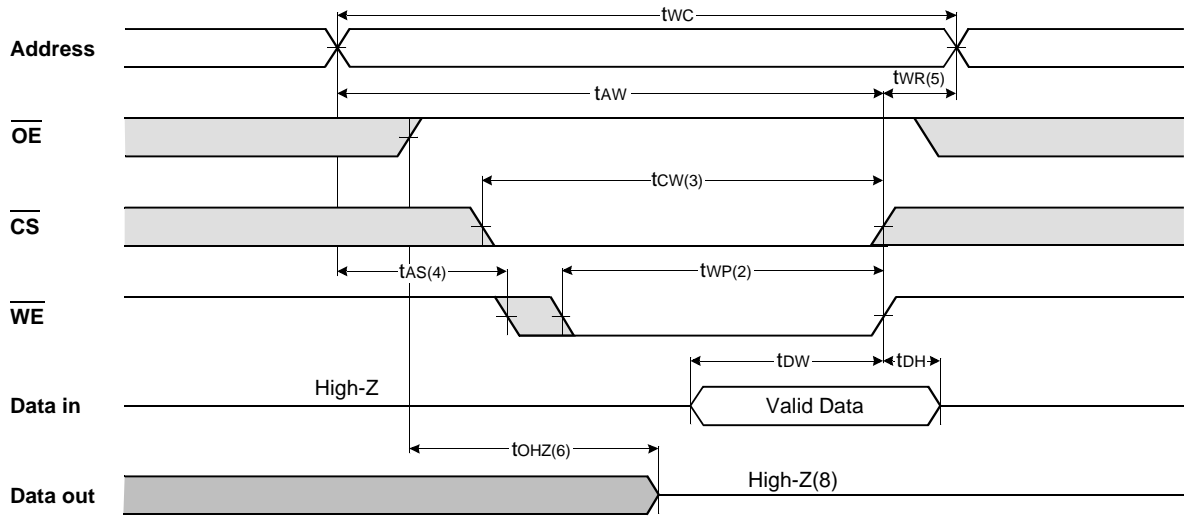
TIMING WAVEFORM OF READ CYCLE(2) ($\overline{WE}=V_{IH}$)



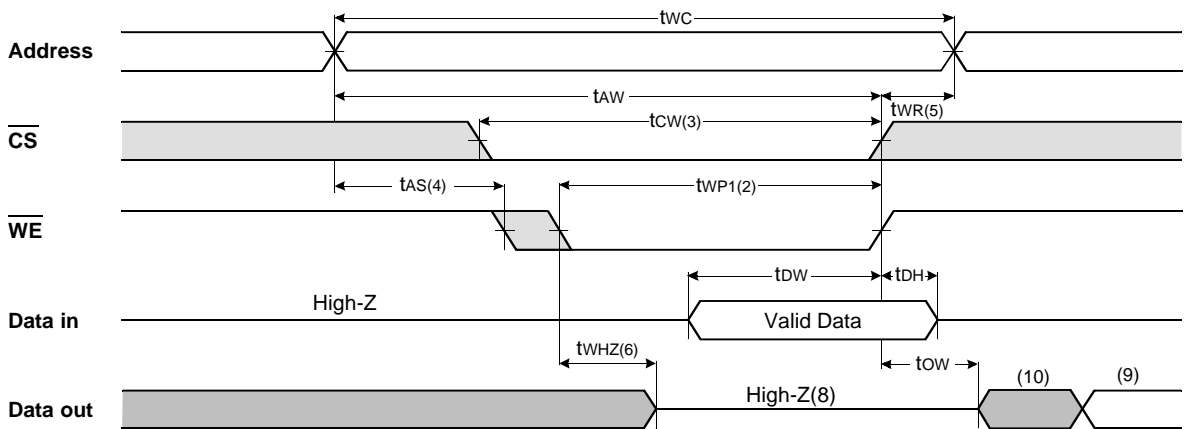
NOTES(READ CYCLE)

- \overline{WE} is high for read cycle.
- All read cycle timing is referenced from the last valid address to the first transition address.
- tHZ and tOHZ are defined as the time at which the outputs achieve the open circuit condition and are not referenced to V_{OH} or V_{OL} levels.
- At any given temperature and voltage condition, tHZ(Max.) is less than tLZ(Min.) both for a given device and from device to device.
- Transition is measured $\pm 200mV$ from steady state voltage with Load(B). This parameter is sampled and not 100% tested.
- Device is continuously selected with $\overline{CS}=V_{IL}$.
- Address valid prior to coincident with CS transition low.
- For common I/O applications, minimization or elimination of bus contention conditions is necessary during read and write cycle.

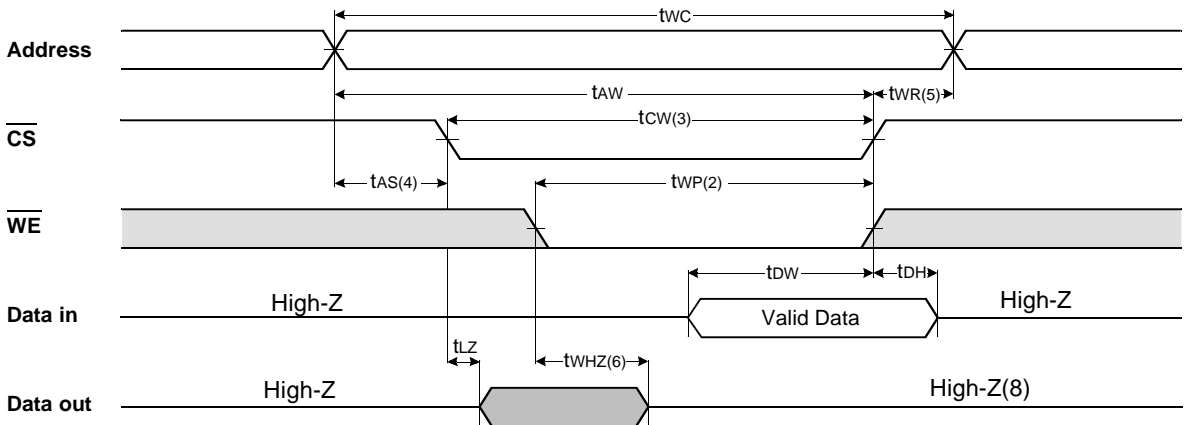
TIMING WAVEFORM OF WRITE CYCLE(1) (\overline{OE} = Clock)



TIMING WAVEFORM OF WRITE CYCLE(2) (\overline{OE} =Low Fixed)



TIMING WAVEFORM OF WRITE CYCLE(3) (\overline{CS} =Controlled)



NOTES(WRITE CYCLE)

1. All write cycle timing is referenced from the last valid address to the first transition address.
2. A write occurs during the overlap of a low CS and WE. A write begins at the latest transition \overline{CS} going low and \overline{WE} going low ; A write ends at the earliest transition CS going high or WE going high. t_{WP} is measured from the beginning of write to the end of write.
3. t_{CW} is measured from the later of \overline{CS} going low to end of write.
4. t_{AS} is measured from the address valid to the beginning of write.
5. t_{WR} is measured from the end of write to the address change. t_{WR} applied in case a write ends as \overline{CS} or \overline{WE} going high.
6. If \overline{OE} , CS and WE are in the Read Mode during this period, the I/O pins are in the output low-Z state. Inputs of opposite phase of the output must not be applied because bus contention can occur.
7. For common I/O applications, minimization or elimination of bus contention conditions is necessary during read and write cycle.
8. If CS goes low simultaneously with WE going or after WE going low, the outputs remain high impedance state.
9. Dout is the read data of the new address.
10. When CS is low : I/O pins are in the output state. The input signals in the opposite phase leading to the output should not be applied.

FUNCTIONAL DESCRIPTION

\overline{CS}	\overline{WE}	\overline{OE}	Mode	I/O Pin	Supply Current
H	X	X*	Not Select	High-Z	ISB, ISB1
L	H	H	Output Disable	High-Z	Icc
L	H	L	Read	DOUT	Icc
L	L	X	Write	DIN	Icc

* X means Don't Care.

PACKAGE DIMENSIONS

Units: millimeters/Inches

32-SOJ-400

