ocument Title

128K x16 bit Super Low Power and Low Voltage Full CMOS Static RAM

Revision History

Revision No.	History	Draft Date	Remark
0.0	Design target	October 2, 1996	Advance
0.1	Initial draft - Add KM616FV2000 Family - Erase KM616FU1000 Family and KM616FS1000 Family supprot 2.3~3.3V operating Vcc. - Concept change high power version to low low power version I_{SB1}=10µA(Max) - Add super low power version with special handling I_{SB1}=2.0µA(Max) - Reduce Icc & Icc1 Write : 25mA to 20mA at Vcc=3.6V(Max)	December 1, 1996	Preliminary
1.0	Finalize - Change datasheet format - Erase reverse type package	March 4, 1998	Final

128Kx16 bit Super Low Power and Low Voltage Full CMOS Static RAM

FEATURES

- Process Technology : Full CMOS
- Organization : 128Kx16
- Power Supply Voltage
  KM616FV2000 Family : 3.0V ~ 3.6V
  KM616FS2000 Family : 2.3V ~ 3.3V
  KM616FR2000 Family : 1.8V ~ 2.7V
- Low Data Retention Voltage : 1.5V(Min)
- Three state output status and TTL Compatible
- Package Type : 44-TSOP2-400F

GENERAL DESCRIPTION

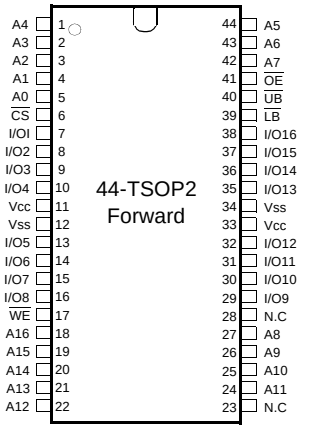
The KM616FV2000, KM616FS2000 and KM616FR2000 families are fabricated by SAMSUNG′s advanced Full CMOS process technology. The families support various operating temperature ranges for user flexibility of system design. The families also support low data retention voltage for battery back-up operation with low data retention current.

PRODUCT FAMILY

Product Family	Operating Temperature	Vcc Range	Speed(ns)	Power Dissipation		PKG Type
				Standby (I_{SB1}, Max)	Operating (I_{CC2}, Max)	
KM616FV2000	Commercial(0~70°C)	3.0~3.6V	70[1]/85@Vcc=3.3±0.3V	10μA[2]	80mA	44-TSOP2-Forward
KM616FS2000		2.3~3.3V	85@Vcc=3.0±0.3V		80mA	
			120[1]/150@Vcc=2.5±0.2V		50mA	
KM616FR2000		1.8~2.7V	300[1]@Vcc=2.0±0.2V		20mA	
KM616FV2000I	Industrial(-40~85°C)	3.0~3.6V	70[1]/85@Vcc=3.3±0.3V		80mA	
KM616FS2000I		2.3~3.3V	85@Vcc=3.0±0.3V		80mA	
			120[1]/150@Vcc=2.5±0.2V		50mA	
KM616FR2000I		1.8~2.7V	300[1]@Vcc=2.0±0.2V		20mA	

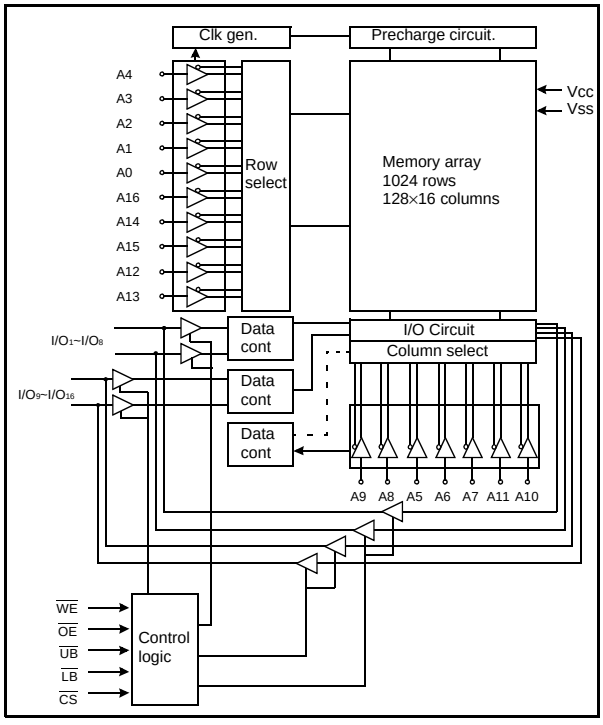
1. The parameter is measured with 30pF test load.
2. Super low power product=2μA with special handling.

PIN DESCRIPTION



Name	Function	Name	Function
$\overline{CS}$	Chip Select Input	$\overline{LB}$	Lower Byte($I/O_{1\sim8}$)
$\overline{OE}$	Output Enable Input	$\overline{UB}$	Upper Byte($I/O_{9\sim16}$)
$\overline{WE}$	Write Enable Input	Vcc	Power
A_0~A_{16}	Address Inputs	Vss	Ground
I/O_1~I/O_{16}	Data Inputs/Outputs	N.C.	No Connection

FUNCTIONAL BLOCK DIAGRAM



PRODUCT LIST

Commercial Temperature Products(0~70°C)		Industrial Temperature Products(-40~85°C)	
Part Name	**Function**	**Part Name**	**Function**
KM616FV2000T-7	44-TSOP2 F, 70ns, 3.3V, LL	KM616FV2000TI-7	44-TSOP2 F, 70ns, 3.3V, LL
KM616FV2000T-8	44-TSOP2 F, 85ns, 3.3V, LL	KM616FV2000TI-8	44-TSOP2 F, 85ns, 3.3V, LL
KM616FS2000T-12	44-TSOP2 F, 120/85ns, 2.5/3.0V, LL	KM616FS2000TI-12	44-TSOP2 F, 120/85ns, 2.5/3.0V, LL
KM616FS2000T-15	44-TSOP2 F, 150/85ns, 2.5/3.0V, LL	KM616FS2000TI-15	44-TSOP2 F, 150/85ns, 2.5/3.0V, LL
KM616FR2000T-30	44-TSOP2 F, 300ns, 2.0/2.5V, LL	KM616FR2000TI-30	44-TSOP2 F, 300ns, 2.0/2.5V, LL

FUNCTIONAL DESCRIPTION

$\overline{CS}$	$\overline{OE}$	$\overline{WE}$	$\overline{LB}$	$\overline{UB}$	I/O1~8	I/O9~16	Mode	Power
H	X[1]	X[1]	X[1]	X[1]	High-Z	High-Z	Deselected	Standby
L	H	H	X[1]	X[1]	High-Z	High-Z	Output Disabled	Active
L	X[1]	X[1]	H	H	High-Z	High-Z	Output Disabled	Active
L	L	H	L	H	Dout	High-Z	Lower Byte Read	Active
L	L	H	H	L	High-Z	Dout	Upper Byte Read	Active
L	L	H	L	L	Dout	Dout	Word Read	Active
L	X[1]	L	L	H	Din	High-Z	Lower Byte Write	Active
L	X[1]	L	H	L	High-Z	Din	Upper Byte Write	Active
L	X[1]	L	L	L	Din	Din	Word Write	Active

1. X means don't care. (Must be in low or high state)

ABSOLUTE MAXIMUM RATINGS[1]

Item	Symbol	Ratings	Unit	Remark
Voltage on any pin relative to Vss	V_{IN},V_{OUT}	-0.2 to 3.6V[2]	V	-
Voltage on Vcc supply relative to Vss	V_{CC}	-0.2 to 4.0V[3]	V	-
Power Dissipation	P_D	1.0	W	-
Storage temperature	T_{STG}	-55 to 150	°C	-
Operating Temperature	T_A	0 to 70	°C	KM616FV2000, KM616FS2000, KM616FR2000
		-40 to 85	°C	KM616FV2000I, KM616FS2000I, KM616FR2000I
Soldering temperature and time	T_{SOLDER}	260°C, 5sec (Lead Only)	-	-

1. Stresses greater than those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. Functional operation should be restricted to recommended operating condition. Exposure to absolute maximum rating conditions for extended periods may affect reliability.
2. V_{IN}/V_{OUT}=-0.2 to 3.9V for KM616FV2000 Family.
3. V_{CC}=-0.2 to 4.6V for KM616FV2000 Family

RECOMMENDED DC OPERATING CONDITIONS[1)]

Item	Symbol	Product		Min	Typ	Max	Unit
Supply voltage	Vcc	KM616FV2000 Family		3.0	3.3	3.6	V
		KM616FS2000 Family		2.3	2.5/3.0	3.3	
		KM616FR2000 Family		1.8	2.0/2.5	2.7	
Ground	Vss	All Family		0	0	0	V
Input high voltage	V_{IH}	KM616FV2000 Family	Vcc=3.3±0.3V	2.2	-	Vcc+0.2[2)]	V
		KM616FS2000 Family	Vcc=3.0±0.3V	2.2			
			Vcc=2.5±0.2V	2.0			
		KM616FR2000 Family	Vcc=2.5±0.2V	2.0			
			Vcc=2.0±0.2V	1.6			
Input low voltage	V_{IL}	All Family		-0.2[3)]	-	0.4	V

Note
1 Commercial Product : T_A=0 to 70°C, unless otherwise specified
Industrial Product : T_A=-40 to 85°C, unless otherwise specified
2. Overshoot : Vcc + 1.0V in case of pulse width ≤20ns
3. Undershoot : -1.0V in case of pulse width ≤20ns
4. Overshoot and undershoot are sampled, not 100% tested.

CAPACITANCE[1)] (f=1MHz, T_A=25°C)

Item	Symbol	Test Condition	Min	Max	Unit
Input capacitance	C_{IN}	V_{IN}=0V	-	8	pF
Input/Output capacitance	C_{IO}	V_{IO}=0V	-	10	pF

1. Capacitance is sampled, not 100% tested

DC AND OPERATING CHARACTERISTICS

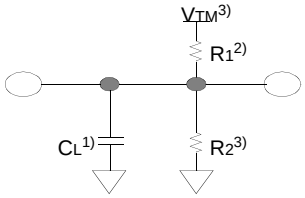
Item	Symbol	Test Conditions		Min	Typ	Max	Unit
Input leakage current	I_{LI}	V_{IN}=Vss to Vcc		-1	-	1	µA
Output leakage current	I_{LO}	$\overline{CS}$=V_{IH} or $\overline{OE}$=V_{IH} or $\overline{WE}$=V_{IL}, V_{IO}=Vss to Vcc		-1	-	1	µA
Operating power supply current	I_{CC}	I_{IO}=0mA, $\overline{CS}$=V_{IL}, V_{IN}=V_{IL} or V_{IH}, Read		-	-	3	mA
Average operating current	I_{CC1}	Cycle time=1µs, 100% duty, I_{IO}=0mA, $\overline{CS}$≤0.2V, V_{IN}≤0.2V or V_{IN}≥Vcc-0.2V	Read	-	-	7	mA
			Write	-	-	20	
	I_{CC2}	Cycle time=Min, 100% duty, I_{IO}=0mA, $\overline{CS}$=V_{IL}, V_{IN}=V_{IL} or V_{IH}	Vcc=3.3V@70ns	-	-	70	mA
			Vcc=2.7V@120ns	-	-	60	
			Vcc=2.2V@300ns	-	-	20	
Output low voltage	V_{OL}	I_{OL}	2.1mA at Vcc=3.0/3.3V	-	-	0.4	V
			0.5mA at Vcc=2.5V	-	-	0.4	
			0.33mA at Vcc=2.0V	-	-	0.4	
Output high voltage	V_{OH}	I_{OH}	-1.0mA at Vcc=3.0/3.3V	2.4	-	-	V
			-0.5mA at Vcc=2.5V	2.0	-	-	
			-0.44mA at Vcc=2.0V	1.6	-	-	
Standby Current(TTL)	I_{SB}	$\overline{CS}$=V_{IH}, Other inputs=V_{IL} or V_{IH}		-	-	0.3	mA
Standby Current(CMOS)	I_{SB1}	$\overline{CS}$≥Vcc-0.2V, Other inputs=0~Vcc		-	-	10[1)]	µA

1. Super low power product=2µA with special handling.

AC OPERATING CONDITIONS

TEST CONDITIONS (Test Load and Test Input/Output Reference)

Input pulse level : 0.4 to 2.2V for Vcc=3.3V, 3.0V, 2.5V
0.4 to 1.8V for Vcc=2.0V
Input rising and falling time : 5ns
Input and output reference voltage : 1.5V for Vcc=3.3V, 3.0V
1.1V for Vcc=2.5V
0.9V for Vcc=2.0V
Output load (See right) : C_L=100pF+1TTL
C_L=30pF+1TTL



1. Including scope and jig capacitance
2. R_1=3070Ω, R_2=3150Ω
3. V_{TM} =2.8V for V_{CC}=3.0/3.3V
=2.3V for V_{CC}=2.5V
=1.8V for V_{CC}=2.0V

AC CHARACTERISTICS (Commercial product :T_A=0 to 70°C, Industrial product : T_A=-40 to 85°C
KM616FV2000 Family : Vcc=3.0~3.6V, KM616FS2000 Family : Vcc=2.3~3.3V,
KM616FR2000 Family : Vcc=1.8~2.7V)

Parameter List		Symbol	Speed Bins										Units
			70ns		85ns		120ns		150ns		300ns		
			Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	
Read	Read cycle time	t_{RC}	70	-	85	-	120	-	150	-	300	-	ns
	Address access time	t_{AA}	-	70	-	85	-	120	-	150	-	300	ns
	Chip select to output	t_{CO}	-	70	-	85	-	120	-	150	-	300	ns
	Output enable to valid output	t_{OE}	-	35	-	45	-	60	-	75	-	150	ns
	$\overline{UB}$, $\overline{LB}$ Access Time	t_{BA}	-	35	-	45	-	60	-	75	-	150	ns
	Chip select to low-Z output	t_{LZ}	10	-	10	-	20	-	20	-	50	-	ns
	Output enable to low-Z output	t_{OLZ}, t_{BLZ}	5	-	5	-	20	-	20	-	30	-	ns
	Chip disable to high-Z output	t_{HZ}	0	25	0	25	0	35	0	40	0	60	ns
	Output disable to high-Z output	t_{OHZ}, t_{BHZ}	0	25	0	25	0	35	0	40	0	60	ns
	Output hold from address change	t_{OH}	10	-	15	-	15	-	15	-	30	-	ns
Write	Write cycle time	t_{WC}	70	-	85	-	120	-	150	-	300	-	ns
	Chip select to end of write	t_{CW}	60	-	70	-	100	-	120	-	300	-	ns
	Address set-up time	t_{AS}	0	-	0	-	0	-	0	-	0	-	ns
	Address valid to end of write	t_{AW}	65	-	70	-	100	-	120	-	300	-	ns
	Write pulse width	t_{WP}	55	-	60	-	80	-	100	-	200	-	ns
	$\overline{UB}$, $\overline{LB}$ Valid to End of Write	t_{BW}	65	-	70	-	100	-	120	-	300	-	ns
	Write recovery time	t_{WR}	0	-	0	-	0	-	0	-	0	-	ns
	Write to output high-Z	t_{WHZ}	0	25	0	25	0	35	0	40	0	60	ns
	Data to write time overlap	t_{DW}	30	-	35	-	50	-	60	-	120	-	ns
	Data hold from write time	t_{DH}	0	-	0	-	0	-	0	-	0	-	ns
	End write to output low-Z	t_{OW}	5	-	5	-	5	-	5	-	20	-	ns

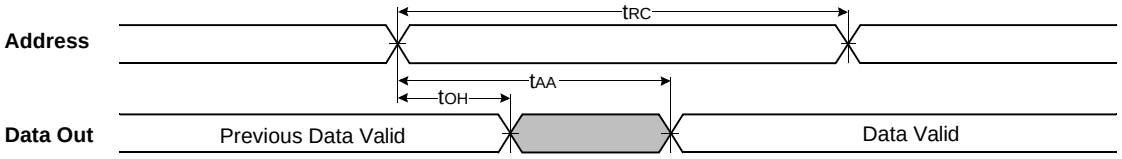
DATA RETENTION CHARACTERISTICS

Item	Symbol	Test Condition	Min	Typ	Max	Unit
Vcc for data retention	V_{DR}	$\overline{CS}$≥Vcc-0.2V	1.5	-	3.6	V
Data retention current	I_{DR}	Vcc=3.0V, $\overline{CS}$≥Vcc-0.2V	-	-	10[1)]	µA
Data retention set-up time	t_{SDR}	See data retention waveform	0	-	-	ns
Recovery time	t_{RDR}		t_{RC}	-	-	

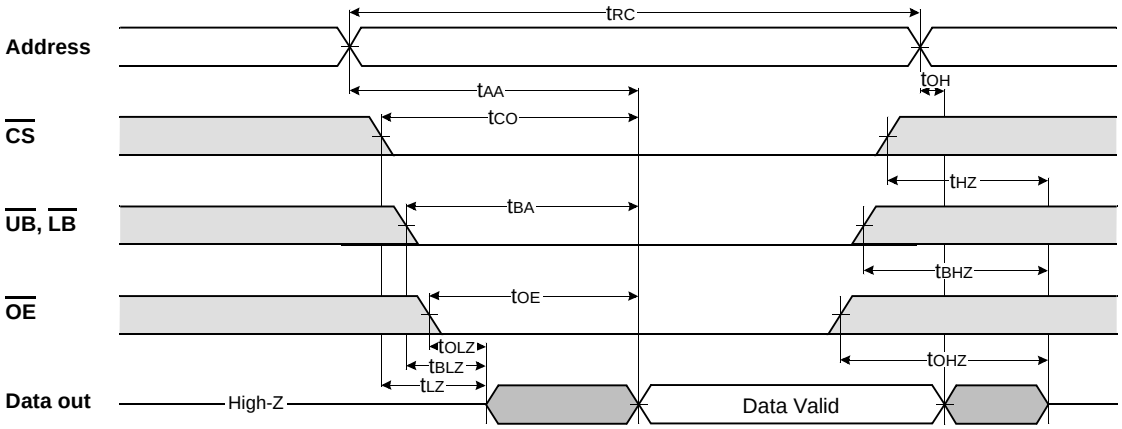
1. Super low power product=2µA with special handling.

TIMMING DIAGRAMS

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



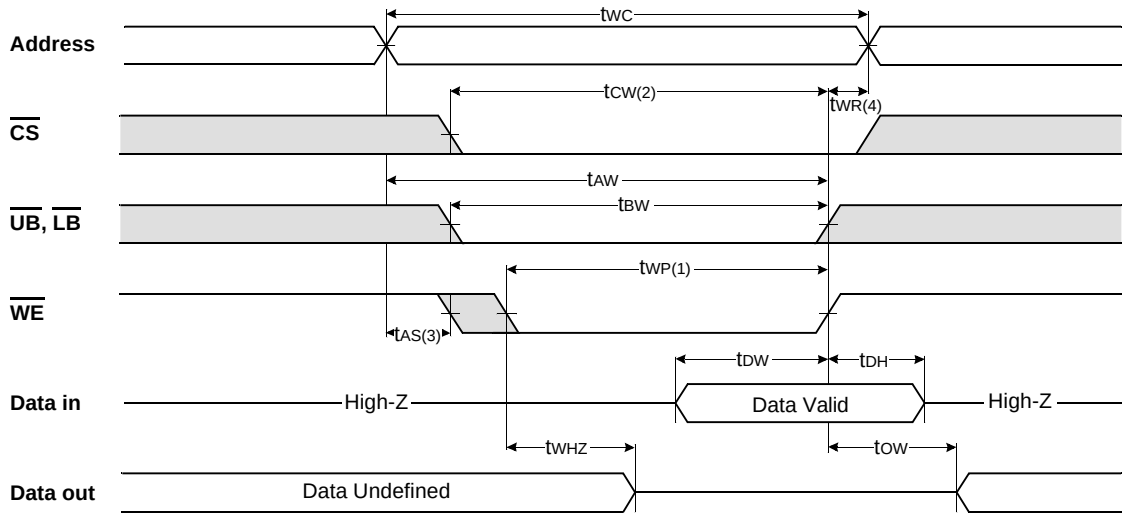
TIMING WAVEFORM OF READ CYCLE(2) ($\overline{WE}$=V_{IH})



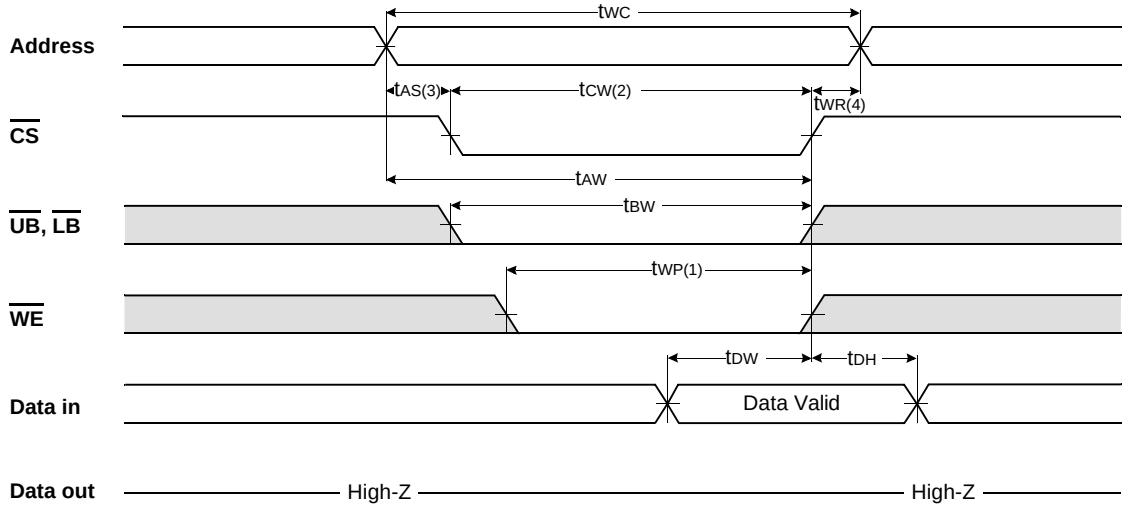
NOTES (READ CYCLE)

1. t_{HZ} and t_{OHZ} are defined as the time at which the outputs achieve the open circuit conditions and are not referenced to output voltage levels.
2. At any given temperature and voltage condition, t_{HZ}(Max.) is less than t_{LZ}(Min.) both for a given device and from device to device interconnection.

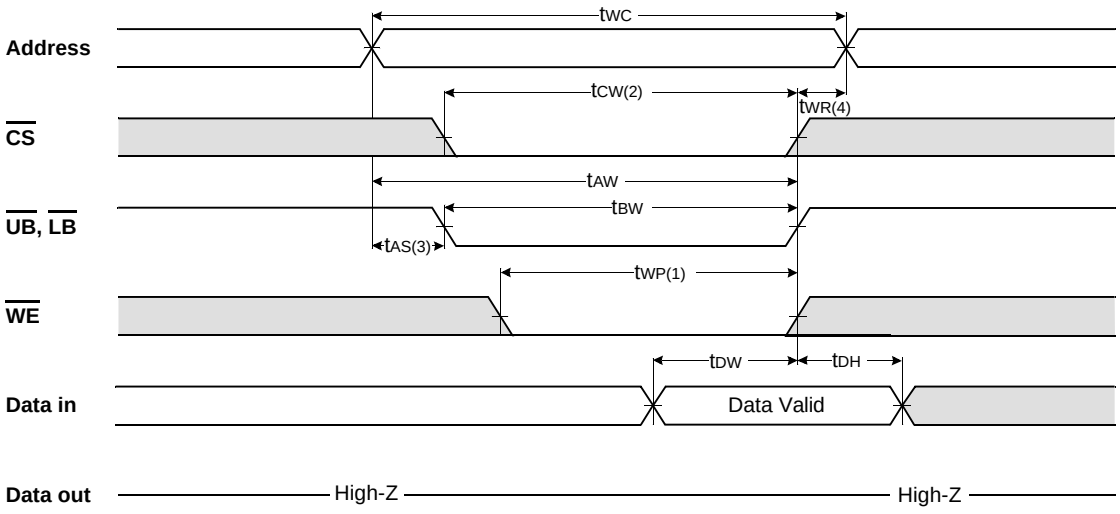
TIMING WAVEFORM OF WRITE CYCLE(1) ($\overline{WE}$ Controlled)



TIMING WAVEFORM OF WRITE CYCLE(2) ($\overline{CS}$ Controlled)



TIMING WAVEFORM OF WRITE CYCLE(3) ($\overline{UB}$, $\overline{LB}$ Controlled)

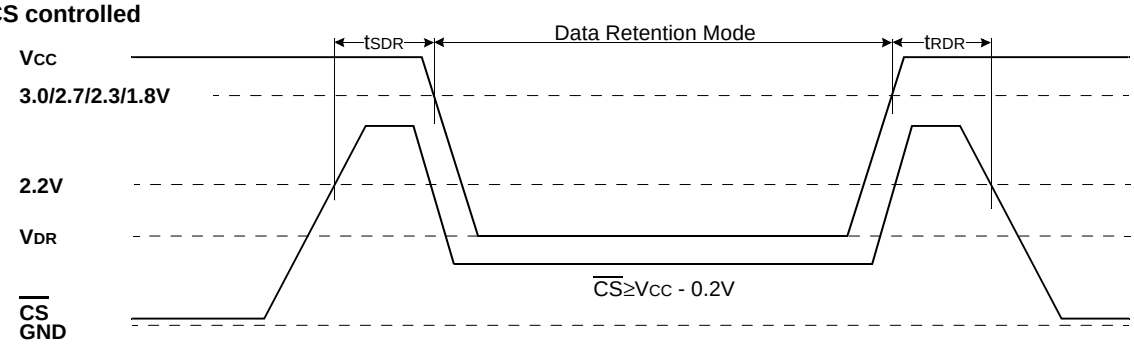


NOTES (WRITE CYCLE)

1. A write occurs during the overlap(t_{WP}) of low $\overline{CS}$ and low $\overline{WE}$. A write begins when $\overline{CS}$ goes low and $\overline{WE}$ goes low with asserting $\overline{UB}$ or $\overline{LB}$ for single byte operation or simultaneously asserting $\overline{UB}$ and $\overline{LB}$ for double byte operation. A write ends at the earliest transition when $\overline{CS}$ goes high and $\overline{WE}$ goes high. The t_{WP} is measured from the beginning of write to the end of write.
2. t_{CW} is measured from the $\overline{CS}$ going low to end of write.
3. t_{AS} is measured from the address valid to the beginning of write.
4. t_{WR} is measured from the end or write to the address change. t_{WR} applied in case a write ends as $\overline{CS}$ or $\overline{WE}$ going high.

DATA RETENTION WAVE FORM

$\overline{CS}$ controlled



PACKAGE DIMENSIONS

Unit : millimeter(inch)

44 PIN THIN SMALL OUTLINE PACKAGE TYPE II (400F)