Document Title

512K x16 bit Super Low Power and Low Voltage Full CMOS Static RAM

Revision History

Revision No.	History	Draft Date	Remark
0.0	Initial draft -Design Target	July 4, 2001	Preliminary
1.0	Finalize	September 26, 2001	Final

512K x 16 bit Super Low Power and Low Voltage Full CMOS Static RAM

FEATURES

- Process Technology: Full CMOS
- Organization: 512K x16
- Power Supply Voltage: 3.0~3.6V
- Low Data Retention Voltage: 1.5V(Min)
- Three State Outputs
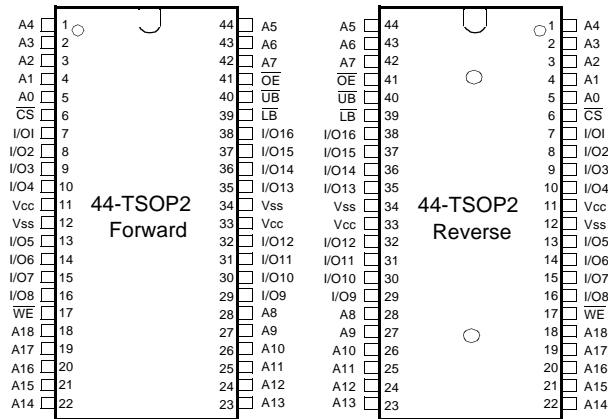- Package Type: 44-TSOP2-400F/R

GENERAL DESCRIPTION

The K6F8016V3A families are fabricated by SAMSUNG's advanced full CMOS process technology. The families support various operating temperature ranges. 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	Power Dissipation		PKG Type
				Standby (I_{SB1}, Typ.)	Operating (I_{CC1}, Max)	
K6F8016V3A-F	Industrial(-40~85°C)	3.0~3.6V	55[1]/70ns	0.5µA[2]	4mA	44-TSOP2-400F/R

1. The parameter is measured with 30pF test load.
2. Typical values are measured at V_{CC}=3.3V, T_A=25°C and not 100% tested.

PIN DESCRIPTION

44-TSOP2 Forward

A4	1	44	A5
A3	2	43	A6
A2	3	42	A7
A1	4	41	$\overline{OE}$
A0	5	40	$\overline{UB}$
$\overline{CS}$	6	39	$\overline{LB}$
I/OI	7	38	I/O16
I/O2	8	37	I/O15
I/O3	9	36	I/O14
I/O4	10	35	I/O13
Vcc	11	34	Vss
Vss	12	33	Vcc
I/O5	13	32	I/O12
I/O6	14	31	I/O11
I/O7	15	30	I/O10
I/O8	16	29	I/O9
$\overline{WE}$	17	28	A8
A18	18	27	A9
A17	19	26	A10
A16	20	25	A11
A15	21	24	A12
A14	22	23	A13

44-TSOP2 Reverse

A5	44	1	A4
A6	43	2	A3
A7	42	3	A2
$\overline{OE}$	41	4	A1
$\overline{UB}$	40	5	A0
$\overline{LB}$	39	6	$\overline{CS}$
I/O16	38	7	I/OI
I/O15	37	8	I/O2
I/O14	36	9	I/O3
I/O13	35	10	I/O4
Vss	34	11	Vcc
Vcc	33	12	Vss
I/O12	32	13	I/O5
I/O11	31	14	I/O6
I/O10	30	15	I/O7
I/O9	29	16	I/O8
A8	28	17	$\overline{WE}$
A9	27	18	A18
A10	26	19	A17
A11	25	20	A16
A12	24	21	A15
A13	23	22	A14

Name	Function	Name	Function
$\overline{CS}$	Chip Select Input	Vcc	Power
$\overline{OE}$	Output Enable Input	Vss	Ground
$\overline{WE}$	Write Enable Input	$\overline{UB}$	Upper Byte(I/O9~16)
A0~A18	Address Inputs	$\overline{LB}$	Lower Byte(I/O1~8)
I/O1~I/O16	Data Inputs/Outputs		

FUNCTIONAL BLOCK DIAGRAM
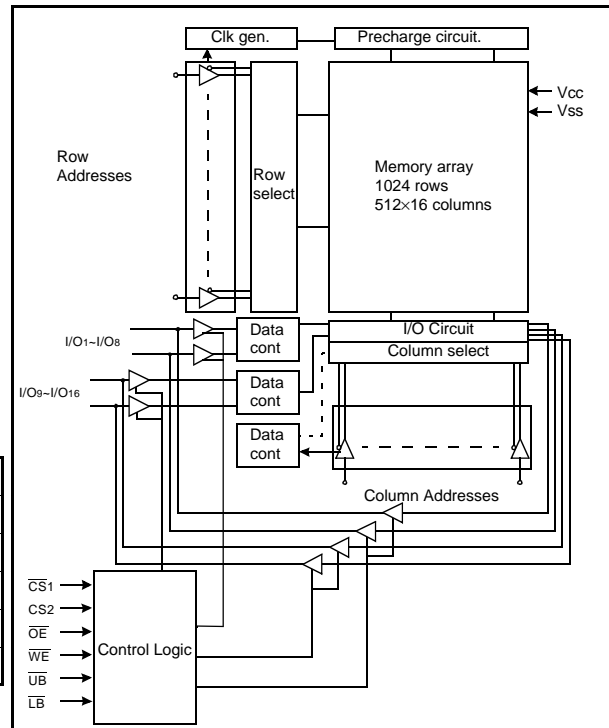
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September 2001

PRODUCT LIST

Industrial Temperature Products(-40~85°C)	
Part Name	**Function**
K6F8016V3A-TF55 K6F8016V3A-TF70	44-TSOP2-F, 55ns, 3.3V 44-TSOP2-F, 70ns, 3.3V
K6F8016V3A-RF55 K6F8016V3A-RF70	44-TSOP2-R, 55ns, 3.3V 44-TSOP2-R, 70ns, 3.3V

FUNCTIONAL DESCRIPTION

$\overline{CS}$	$\overline{OE}$	$\overline{WE}$	$\overline{LB}$	$\overline{UB}$	$I/O_{1\sim8}$	$I/O_{9\sim16}$	Mode	Power
H	X	X	X	X	High-Z	High-Z	Deselected	Standby
L	H	H	X	X	High-Z	High-Z	Output Disabled	Active
L	X	X	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	L	L	H	Din	High-Z	Lower Byte Write	Active
L	X	L	H	L	High-Z	Din	Upper Byte Write	Active
L	X	L	L	L	Din	Din	Word Write	Active

Note : X means don't care. (Must be low or high state)

ABSOLUTE MAXIMUM RATINGS[1)]

Item	Symbol	Ratings	Unit
Voltage on any pin relative to Vss	V_{IN}, V_{OUT}	-0.2 to V_{CC}+0.3V(max.4.0V)	V
Voltage on Vcc supply relative to Vss	V_{CC}	-0.2 to 4.0	V
Power Dissipation	P_D	1.0	W
Storage temperature	T_{STG}	-65 to 150	°C
Operating Temperature	T_A	-40 to 85	°C

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.

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RECOMMENDED DC OPERATING CONDITIONS[1]

Item	Symbol	Min	Typ	Max	Unit
Supply voltage	V_{CC}	3.0	3.3	3.6	V
Ground	V_{SS}	0	0	0	V
Input high voltage	V_{IH}	2.2	-	V_{CC}+0.3[2]	V
Input low voltage	V_{IL}	-0.3[3]	-	0.6	V

Note:
1. Industrial products: T_A=-40 to 85°C, otherwise specified.
2. Overshoot: V_{CC}+2.0V in case of pulse width ≤20ns.
3. Undershoot: -2.0V 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[1]	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}$1=V_{IL}, $\overline{WE}$=V_{IH}, V_{IN}=V_{IH} or V_{IL}	-	-	2	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	-	-	4	mA
	I_{CC2}	Cycle time=Min, I_{IO}=0mA, 100% duty, $\overline{CS}$=V_{IL}, VIN=V_{IL} or V_{IH}	-	-	45	mA
Output low voltage	V_{OL}	I_{OL} = 2.1mA	-	-	0.4	V
Output high voltage	V_{OH}	I_{OH} = -1.0mA	2.4	-	-	V
Standby Current(CMOS)	I_{SB1}	$\overline{CS}$≥Vcc-0.2V, Other inputs=0~Vcc	-	0.5	30	μA

1. Typical values are measured at V_{CC}=3.3V, T_A=25°C and not 100% tested.

AC OPERATING CONDITIONS

TEST CONDITIONS(Test Load and Input/Output Reference)

Input pulse level: 0.4 to 2.2V
Input rising and falling time: 5ns
Input and output reference voltage:1.5V
Output load(see right): C_L=100pF+1TTL
$\qquad\qquad\qquad\quad$ C_L=30pF+1TTL
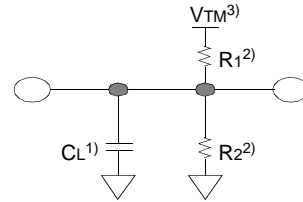
1. Including scope and jig capacitance
2. R_1=3070Ω, R_2=3150Ω
3. V_{TM} =2.8V

AC CHARACTERISTICS (Vcc=3.0~3.6V)

Parameter List		Symbol	Speed Bins				Units
			55ns		70ns		
			Min	Max	Min	Max	
Read	Read Cycle Time	t_{RC}	55	-	70	-	ns
	Address Access Time	t_{AA}	-	55	-	70	ns
	Chip Select to Output	t_{CO}	-	55	-	70	ns
	Output Enable to Valid Output	t_{OE}	-	25	-	35	ns
	$\overline{UB}$, $\overline{LB}$ Access Time	t_{BA}	-	25	-	35	ns
	Chip Select to Low-Z Output	t_{LZ}	10	-	10	-	ns
	$\overline{UB}$, $\overline{LB}$ Enable to Low-Z Output	t_{BLZ}	5	-	5	-	ns
	Output Enable to Low-Z Output	t_{OLZ}	5	-	5	-	ns
	Chip Disable to High-Z Output	t_{HZ}	0	20	0	25	ns
	$\overline{UB}$, $\overline{LB}$ Disable to High-Z Output	t_{BHZ}	0	20	0	25	ns
	Output Disable to High-Z Output	t_{OHZ}	0	20	0	25	ns
	Output Hold from Address Change	t_{OH}	10	-	10	-	ns
Write	Write Cycle Time	t_{WC}	55	-	70	-	ns
	Chip Select to End of Write	t_{CW}	45	-	60	-	ns
	Address Set-up Time	t_{AS}	0	-	0	-	ns
	Address Valid to End of Write	t_{AW}	45	-	60	-	ns
	$\overline{UB}$, $\overline{LB}$ Valid to End of Write	t_{BW}	45	-	60	-	ns
	Write Pulse Width	t_{WP}	40	-	50	-	ns
	Write Recovery Time	t_{WR}	0	-	0	-	ns
	Write to Output High-Z	t_{WHZ}	0	20	0	20	ns
	Data to Write Time Overlap	t_{DW}	25	-	30	-	ns
	Data Hold from Write Time	t_{DH}	0	-	0	-	ns
	End Write to Output Low-Z	t_{OW}	5	-	5	-	ns

DATA RETENTION CHARACTERISTICS

Item	Symbol	Test Condition	Min	Typ[2]	Max	Unit
Vcc for data retention	V_{DR}	$\overline{CS}_1 \geq$Vcc-0.2V[1]	1.5	-	3.6	V
Data retention current	I_{DR}	Vcc=1.5V, $\overline{CS}_1 \geq$Vcc-0.2V[1]	-	0.5	6	μA
Data retention set-up time	t_{SDR}	See data retention waveform	0	-	-	ns
Recovery time	t_{RDR}		t_{RC}	-	-	

1. $\overline{CS}_1 \geq$Vcc-0.2V,$CS_2 \geq$Vcc-0.2V($\overline{CS}_1$ controlled) or $CS_2 \geq$Vcc-0.2V(CS_2 controlled).
2. Typical value are measured at T_A=25°C and not 100% tested.

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TIMING DIAGRAMS

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

Address

t_{RC}

t_{AA}

t_{OH}

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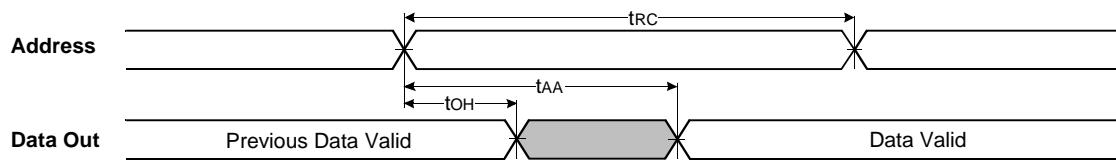
TIMING WAVEFORM OF READ CYCLE(2) ($\overline{WE}=V_{IH}$)

Address

t_{RC}

t_{AA}

t_{OH}

$\overline{CS}$

t_{CO}

t_{HZ}

$\overline{UB}, \overline{LB}$

t_{BA}

t_{BHZ}

$\overline{OE}$

t_{OE}

t_{OLZ}

t_{BLZ}

t_{LZ}
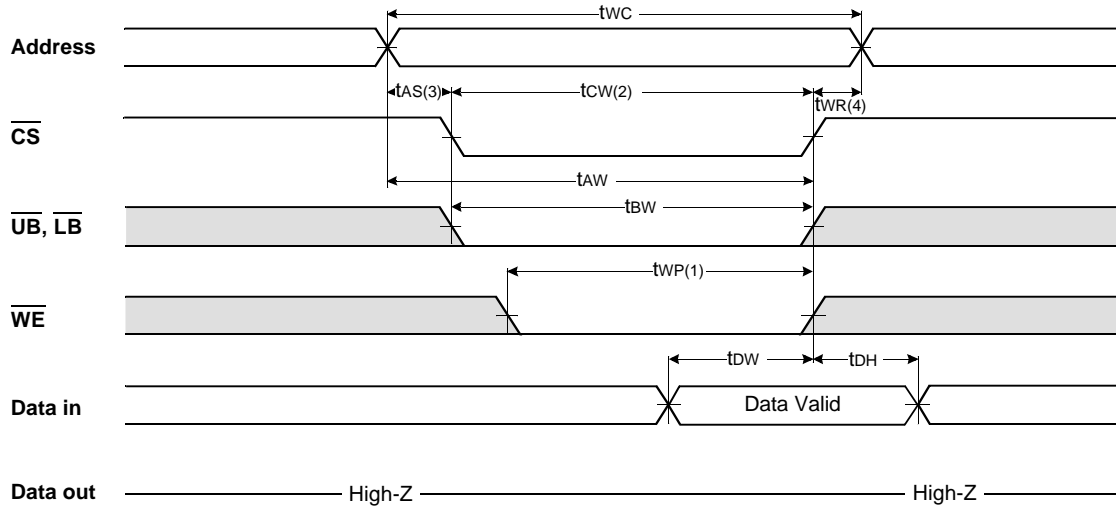
t_{OHZ}

Data out   High-Z   Data Valid
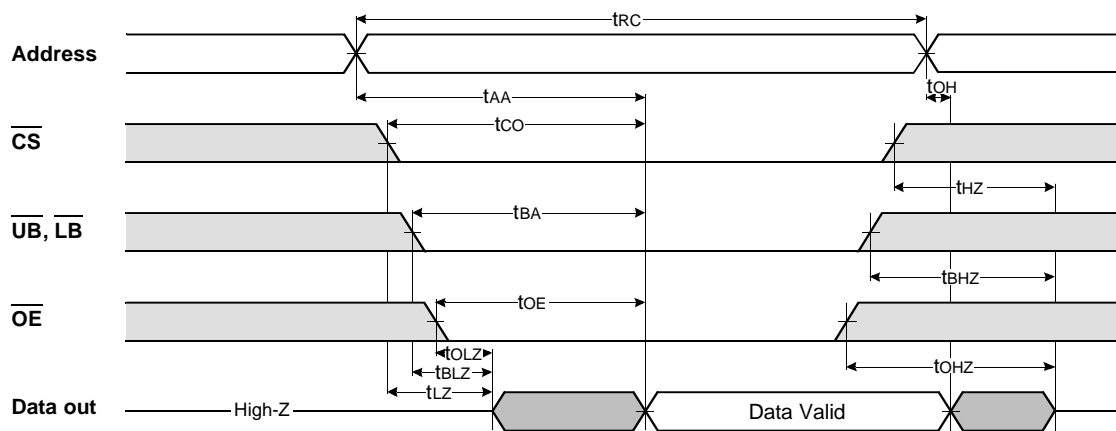
NOTES (READ CYCLE)

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.
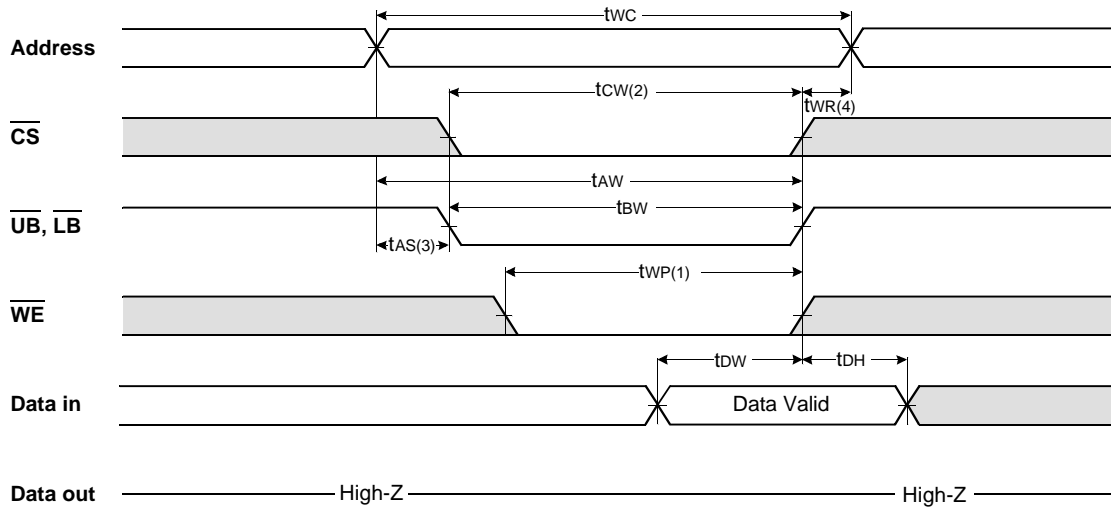
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TIMING WAVEFORM OF WRITE CYCLE(1) ($\overline{WE}$ Controlled)
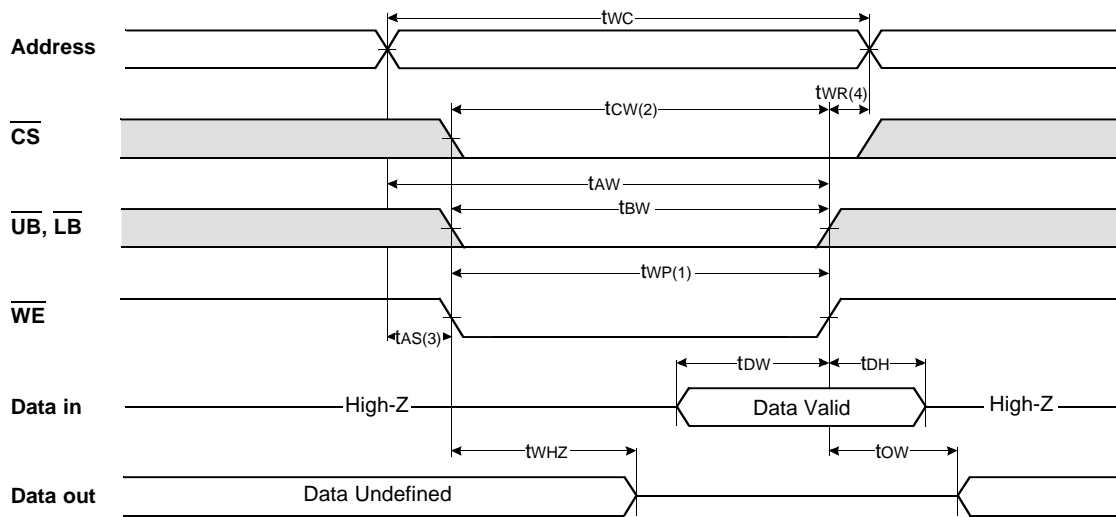
TIMING WAVEFORM OF WRITE CYCLE(2) ($\overline{CS}$ Controlled)

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

Address — twc

$\overline{CS}$ — tcw(2), twr(4)

$\overline{UB}$, $\overline{LB}$ — tAW, tBW, tAS(3)

$\overline{WE}$ — twP(1)

Data in — tDW, tDH — Data Valid

Data out — High-Z — High-Z

NOTES (WRITE CYCLE)

1. A write occurs during the overlap(twP) 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 twP is measured from the beginning of write to the end of write.
2. tcw is measured from the $\overline{CS}$ going low to the end of write.
3. tAS is measured from the address valid to the beginning of write.
4. twR is measured from the end of write to the address change. twR applied in case a write ends as $\overline{CS}$ or $\overline{WE}$ going high.
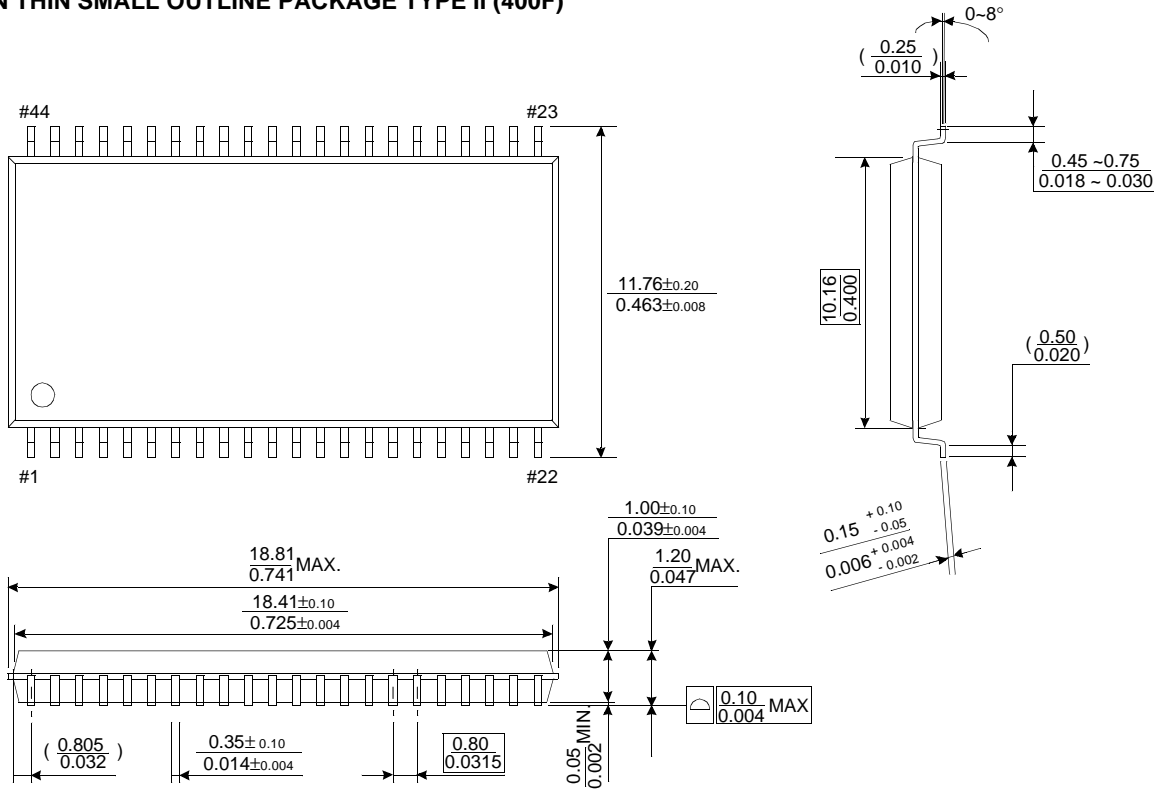
DATA RETENTION WAVE FORM

$\overline{CS}$ controlled

Vcc — tSDR — Data Retention Mode — tRDR

3.0V

2.2V

VDR

$\overline{CS} \geq Vcc - 0.2V$

$\overline{CS}$ GND
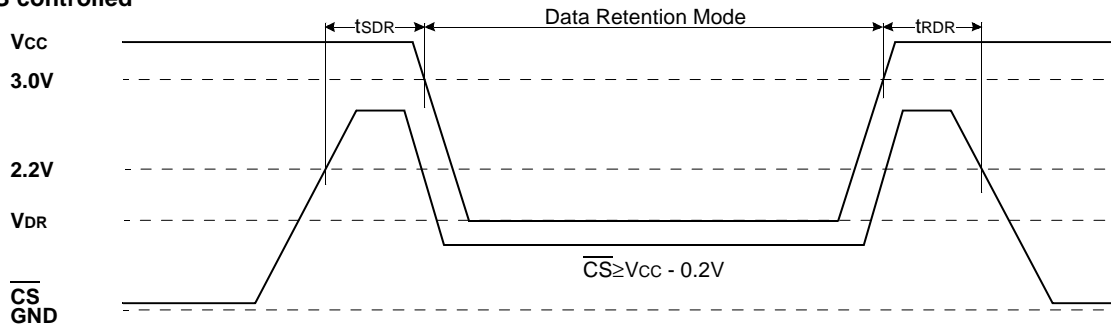
PACKAGE DIMENSION

Unit: millimeters

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

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

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