Document Title

512Kx8 bit Low Power and Low Voltage CMOS Static RAM

Revision History

Revision No.	History	Draft Data	Remark
0.0	Initial Draft	July 29, 2002	Preliminary
0.1	Revised - Added 55ns product(Vcc = 3.0V~3.6V)	October 14, 2002	Preliminary
0.2	Revised - Added Commercial product	December 2, 2002	Preliminary
0.21	Revised - Errata correction : corrected commercial product family name from K6X4008T1F-F to K6X4008T1F-B in PRODUCT FAMILY.	March 26, 2003	Preliminary
1.0	Finalized - Changed I_{CC} from 4mA to 2mA - Changed $I_{CC}1$ from 4mA to 3mA - Changed $I_{CC}2$ from 30mA to 25mA - Changed $I_{SB}1$(Commercial) from 15µA to 10µA - Changed $I_{SB}1$(industrial) from 20µA to 10µA - Changed $I_{SB}1$(Automotive) from 30µA to 20µA - Changed I_{DR}(Commercial) from 15µA to 10µA - Changed I_{DR}(industrial) from 20µA to 10µA - Changed I_{DR}(Automotive) from 30µA to 20µA	September 16, 2003	Final

512K×8 bit Low Power and Low Voltage CMOS Static RAM

FEATURES

- Process Technology: Full CMOS
- Organization: 512K×8
- Power Supply Voltage: 2.7~3.6V
- Low Data Retention Voltage: 2V(Min)
- Three State Outputs
- Package Type: 32-SOP-525, 32-TSOP2-400F/R
  32-TSOP1-0813.4F

GENERAL DESCRIPTION

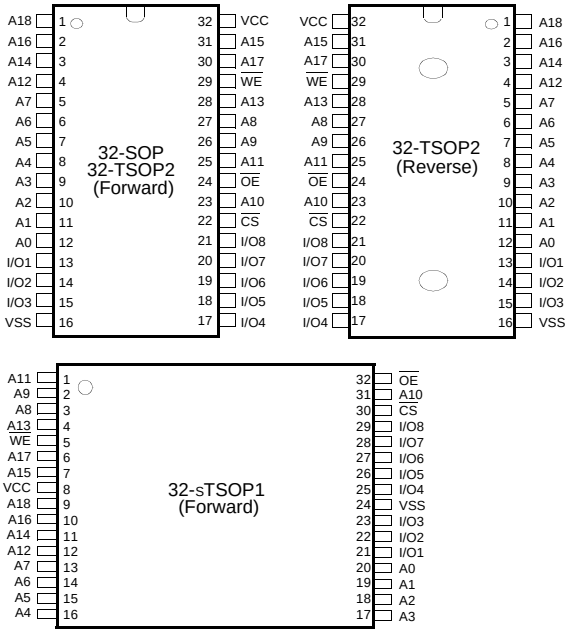
The K6X4008T1F families are fabricated by SAMSUNG′s advanced full CMOS process technology. The families support various operating temperature range and have various package types for user flexibility of system design. The families also support low data retention voltage for battery back-up operation with low data retention current.

PRODUCT FAMILY

Product Family	Operating Temperature	Vcc Range	Speed	Power Dissipation		PKG Type
				Standby (I_{SB1}, Max)	Operating (I_{CC2}, Max)	
K6X4008T1F-B	Commercial(0~70°C)	2.7~3.6V	55[1]/70[2]/85ns	10µA	25mA	32-SOP-525, 32-TSOP1-0813.4F 32-TSOP2-400F/R
K6X4008T1F-F	Industrial(-40~85°C)			10µA		
K6X4008T1F-Q	Automotive(-40~125°C)		70[2]/85ns	20µA		32-SOP-525, 32-TSOP1-0813.4F 32-TSOP2-400F

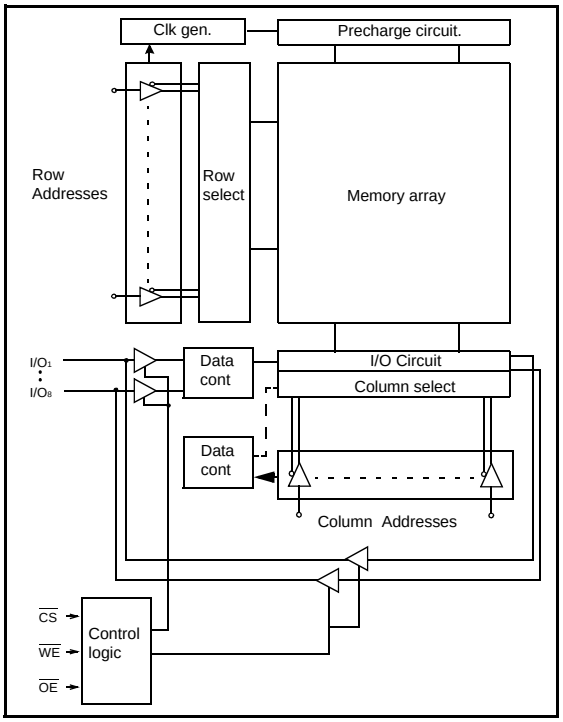
1. This parameter is measured in the voltage range of 3.0V~3.6V with 30pF test load.
2. This parameter is measured with 30pF test load.

PIN DESCRIPTION



Name	Function	Name	Function
A_0~A_{18}	Address Inputs	Vcc	Power
$\overline{WE}$	Write Enable Input	Vss	Ground
$\overline{CS}$	Chip Select Input	I/O_1~I/O_8	Data Inputs/Outputs
$\overline{OE}$	Output Enable Input		

FUNCTIONAL BLOCK DIAGRAM



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PRODUCT LIST

Commercial Products(0~70°C)		Industrial Products(-40~85°C)		Automotive Products(-40~125°C)	
Part Name	**Function**	**Part Name**	**Function**	**Part Name**	**Function**
K6X4008T1F-GB55[1)] K6X4008T1F-GB70 K6X4008T1F-GB85 K6X4008T1F-YB55[1)] K6X4008T1F-YB70 K6X4008T1F-YB85 K6X4008T1F-VB55[1)] K6X4008T1F-VB70 K6X4008T1F-VB85 K6X4008T1F-MB55[1)] K6X4008T1F-MB70 K6X4008T1F-MB85	32-SOP, 55ns, LL 32-SOP, 70ns, LL 32-SOP, 85ns, LL 32-sTSOP1-F, 55ns, LL 32-sTSOP1-F, 70ns, LL 32-sTSOP1-F, 85ns, LL 32-TSOP2-F, 55ns, LL 32-TSOP2-F, 70ns, LL 32-TSOP2-F, 85ns, LL 32-TSOP2-R, 55ns, LL 32-TSOP2-R, 70ns, LL 32-TSOP2-R, 85ns, LL	K6X4008T1F-GF55[1)] K6X4008T1F-GF70 K6X4008T1F-GF85 K6X4008T1F-YF55[1)] K6X4008T1F-YF70 K6X4008T1F-YF85 K6X4008T1F-VF55[1)] K6X4008T1F-VF70 K6X4008T1F-VF85 K6X4008T1F-MF55[1)] K6X4008T1F-MF70 K6X4008T1F-MF85	32-SOP, 55ns, LL 32-SOP, 70ns, LL 32-SOP, 85ns, LL 32-sTSOP1-F, 55ns, LL 32-sTSOP1-F, 70ns, LL 32-sTSOP1-F, 85ns, LL 32-TSOP2-F, 55ns, LL 32-TSOP2-F, 70ns, LL 32-TSOP2-F, 85ns, LL 32-TSOP2-R, 55ns, LL 32-TSOP2-R, 70ns, LL 32-TSOP2-R, 85ns, LL	K6X4008T1F-GQ70 K6X4008T1F-GQ85 K6X4008T1F-YQ70 K6X4008T1F-YQ85 K6X4008T1F-VQ70 K6X4008T1F-VQ85	32-SOP, 70ns, L 32-SOP, 85ns, L 32-sTSOP1-F, 70ns, L 32-sTSOP1-F, 85ns, L 32-TSOP2-F, 70ns, L 32-TSOP2-F, 85ns, L

1. Operating voltage range is 3.0V~3.6V

FUNCTIONAL DESCRIPTION

$\overline{CS}$	$\overline{OE}$	$\overline{WE}$	I/O	Mode	Power
H	X[1)]	X[1)]	High-Z	Deselected	Standby
L	H	H	High-Z	Output Disabled	Active
L	L	H	Dout	Read	Active
L	X[1)]	L	Din	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 V_{CC}+0.3(max. 3.9V)	V	-
Voltage on Vcc supply relative to Vss	V_{CC}	-0.2 to 3.9	V	-
Power Dissipation	P_D	1.0	W	-
Storage temperature	T_{STG}	-65 to 150	°C	-
Operating Temperature	T_A	0 to 70	°C	K6F4008T1F-B
		-40 to 85	°C	K6F4008T1F-F
		-40 to 125	°C	K6F4008T1F-Q

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.

RECOMMENDED DC OPERATING CONDITIONS[1)]

Item	Symbol	Min	Typ	Max	Unit
Supply voltage	Vcc	2.7	3.0/3.3	3.6	V
Ground	Vss	0	0	0	V
Input high voltage	V_{IH}	2.2	-	Vcc+0.2[2)]	V
Input low voltage	V_{IL}	-0.2[3)]	-	0.6	V

Note:
1. Commercial Product: T_A=0 to 70°C, otherwise specified
   Industrial Product: T_A=-40 to 85°C, otherwise specified
   Automotive Product: T_A=-40 to 125°C, otherwise specified
2. Overshoot: V_{CC}+2.0V in case of pulse width ≤ 30ns
3. Undershoot: -2.0V in case of pulse width ≤ 30ns
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

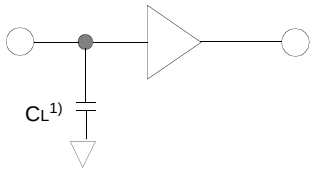
Item	Symbol	Test Conditions		Min	Typ	Max	Unit
Input leakage current	I_{LI}	V_{IN}=Vss to Vcc		-1	-	1	µA
Output leakage current	I_{LO}	$\overline{CS}$=V_{IH} or $\overline{OE}$=V_{IH} or $\overline{WE}$=V_{IL} V_{IO}=Vss to Vcc		-1	-	1	µA
Operating power supply current	I_{CC}	I_{IO}=0mA, $\overline{CS}$=V_{IL}, V_{IN}=V_{IL} or V_{IH}, Read		-	-	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		-	-	3	mA
	I_{CC2}	Cycle time=Min, 100% duty, I_{IO}=0mA, $\overline{CS}$=V_{IL}, V_{IN}=V_{IH} or V_{IL}		-	-	25	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(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	K6X4008T1F-B	-	-	10	µA
			K6X4008T1F-F	-	-	10	µA
			K6X4008T1F-Q	-	-	20	µA

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
C_L[1)]=30pF+1TTL

1. 55ns, 70ns product



1. Including scope and jig capacitance

AC CHARACTERISTICS

(V_{CC}=2.7~3.6V, Commercial product: T_A=0 to 70°C, Industrial product: T_A=-40 to 85°C, Automotive product: T_A=-40 to 125°C)

Parameter List		Symbol	Speed Bins						Units
			55ns[1)]		70ns		85ns		
			Min	Max	Min	Max	Min	Max	
Read	Read cycle time	t_{RC}	55	-	70	-	85	-	ns
	Address access time	t_{AA}	-	55	-	70	-	85	ns
	Chip select to output	t_{CO}	-	55	-	70	-	85	ns
	Output enable to valid output	t_{OE}	-	25	-	35	-	40	ns
	Chip select to low-Z output	t_{LZ}	10	-	10	-	10	-	ns
	Output enable to low-Z output	t_{OLZ}	5	-	5	-	5	-	ns
	Chip disable to high-Z output	t_{HZ}	0	20	0	25	0	25	ns
	Output disable to high-Z output	t_{OHZ}	0	20	0	25	0	25	ns
	Output hold from address change	t_{OH}	10	-	10	-	10	-	ns
Write	Write cycle time	t_{WC}	55	-	70	-	85	-	ns
	Chip select to end of write	t_{CW}	45	-	60	-	70	-	ns
	Address set-up time	t_{AS}	0	-	0	-	0	-	ns
	Address valid to end of write	t_{AW}	45	-	60	-	70	-	ns
	Write pulse width	t_{WP}	40	-	55	-	55	-	ns
	Write recovery time	t_{WR}	0	-	0	-	0	-	ns
	Write to output high-Z	t_{WHZ}	0	20	0	25	0	25	ns
	Data to write time overlap	t_{DW}	25	-	30	-	35	-	ns
	Data hold from write time	t_{DH}	0	-	0	-	0	-	ns
	End write to output low-Z	t_{OW}	5	-	5	-	5	-	ns

1. Voltage range is 3.0V~3.6V for commercial and industrial product.

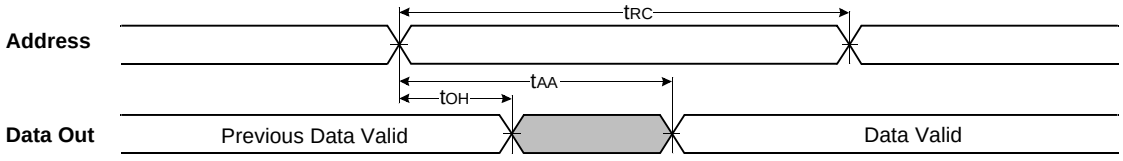
DATA RETENTION CHARACTERISTICS

Item	Symbol	Test Condition		Min	Typ[1)]	Max	Unit
Vcc for data retention	V_{DR}	$\overline{CS}$≥Vcc-0.2V		2.0	-	3.6	V
Data retention current	I_{DR}	Vcc=3.0V, $\overline{CS}$≥Vcc-0.2V	K6X4008T1F-B	-	0.5	10	µA
			K6X4008T1F-F	-		10	µA
			K6X4008T1F-Q	-		20	µA
Data retention set-up time	t_{SDR}	See data retention waveform		0	-	-	ms
Recovery time	t_{RDR}			5	-	-	

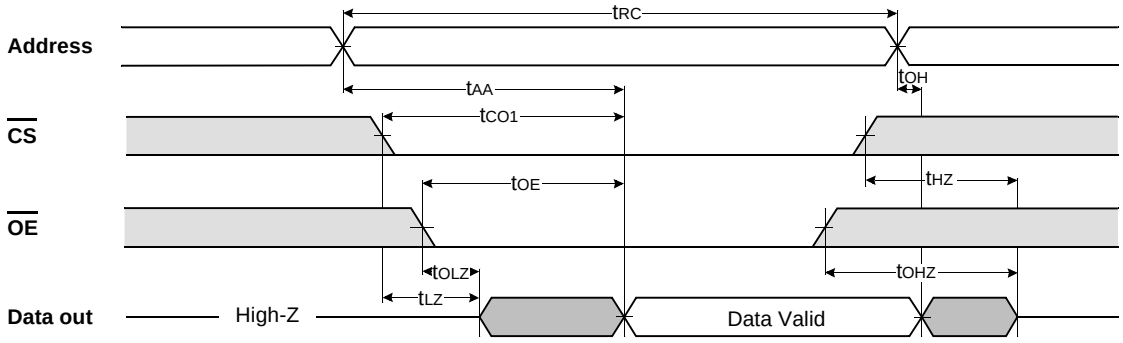
1. Typical values are measured at T_A = 25°C and not 100% tested.

TIMING DIAGRAMS

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



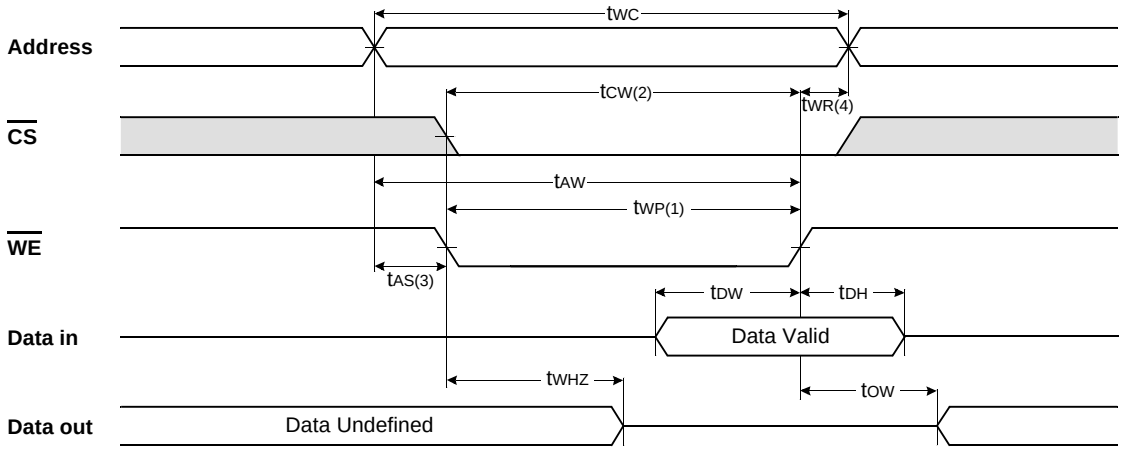
TIMING WAVEFORM OF READ CYCLE(2) ($\overline{WE}$=V_{IH})



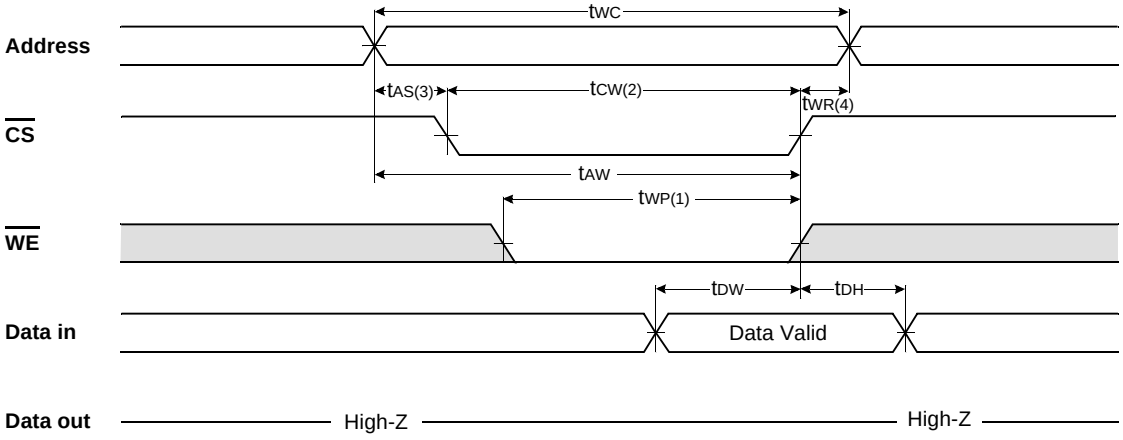
NOTES (READ CYCLE)

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)

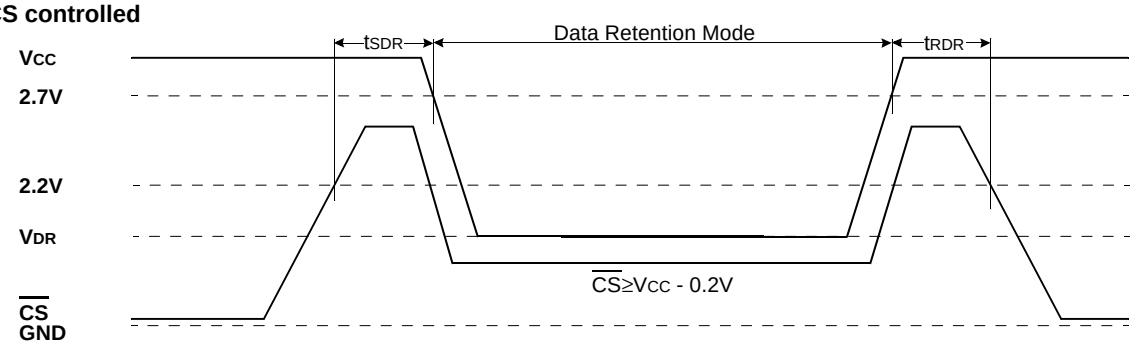


NOTES (WRITE CYCLE)

1. A write occurs during the overlap of a low $\overline{CS}$ and a low $\overline{WE}$. A write begins at the latest transition among $\overline{CS}$ going Low and $\overline{WE}$ going low : A write end at the earliest transition among $\overline{CS}$ going high and $\overline{WE}$ going high, t_{WP} is measured from the begining of write to the end of write.
2. t_{CW} is measured from the $\overline{CS}$ going low to the 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 of write to the address change. t_{WR} is applied in case a write ends with $\overline{CS}$ or $\overline{WE}$ going high.

DATA RETENTION WAVE FORM

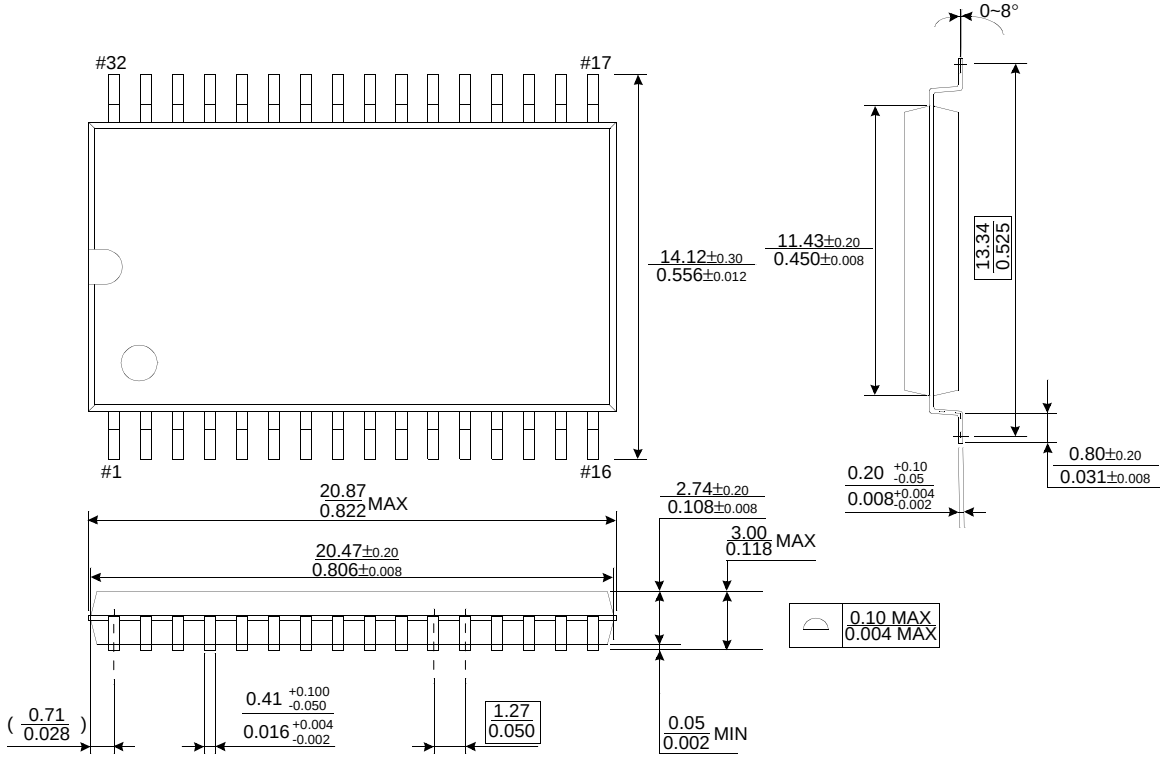
$\overline{CS}$ controlled



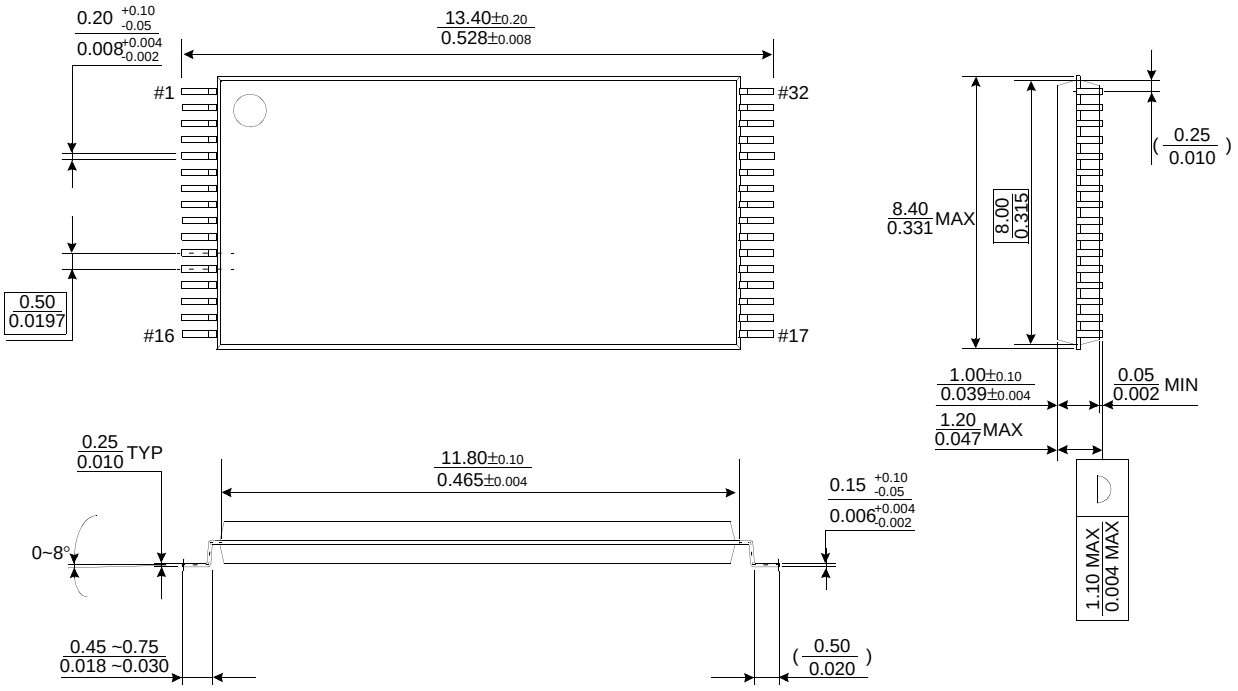
PACKAGE DIMENSIONS

Units: millimeters(inches)

32 PIN PLASTIC SMALL OUTLINE PACKAGE (525mil)



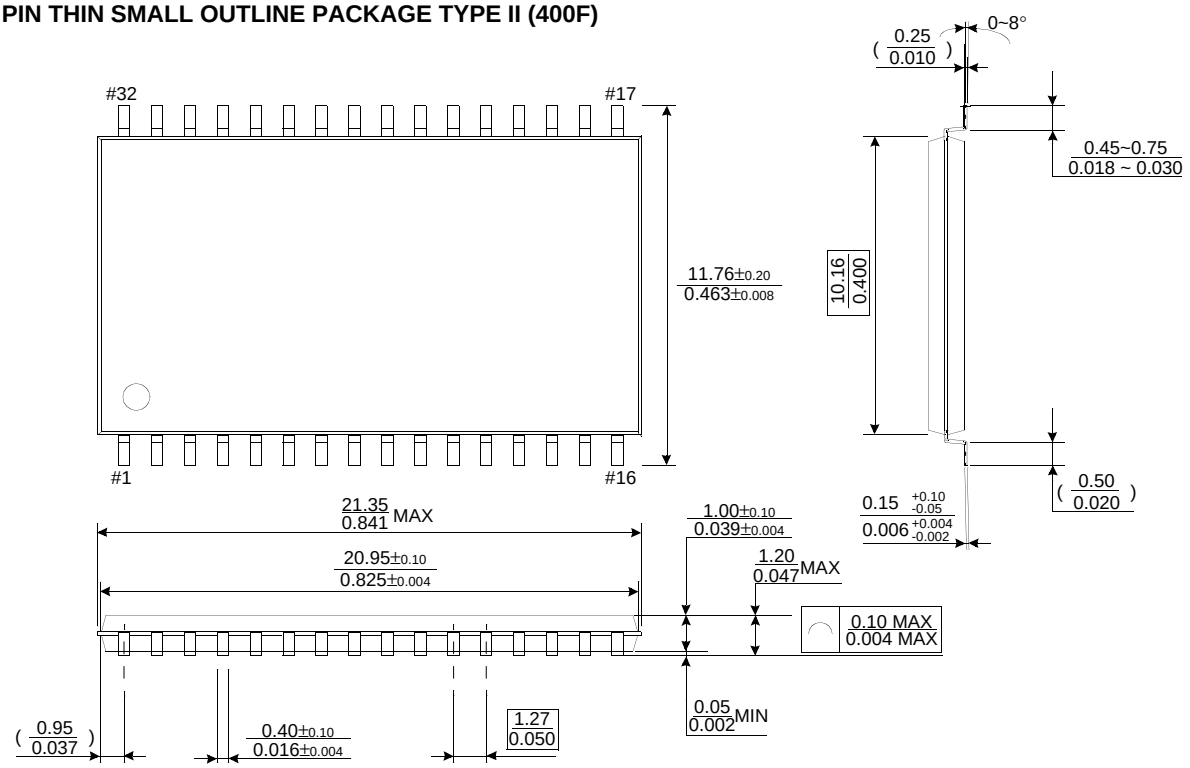
32 PIN SMALLER THIN SMALL OUTLINE PACKAGE TYPE I (0813.4F)



PACKAGE DIMENSIONS

Units: millimeters(inches)

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



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