

Document Title**512Kx8 bit Low Power and Low Voltage CMOS Static RAM****Revision History**

| <u>Revision No.</u> | <u>History</u> | <u>Draft Data</u> | <u>Remark</u> |
|----------------------------|---|--------------------------|----------------------|
| 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 Icc from 4mA to 2mA - Changed Icc1 from 4mA to 3mA - Changed Icc2 from 30mA to 25mA - Changed Isb1(Commercial) from 15μA to 10μA - Changed Isb1(industrial) from 20μA to 10μA - Changed Isb1(Automotive) from 30μA to 20μA - Changed IDR(Commercial) from 15μA to 10μA - Changed IDR(industrial) from 20μA to 10μA - Changed IDR(Automotive) from 30μA to 20μA | September 16, 2003 | Final |
| 2.0 | Revised - Added lead free product - Changed Isb1(Automotive) from 20μA to 30μA - Changed IDR(Automotive) from 20μA to 30μA | March 7, 2005 | Final |

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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

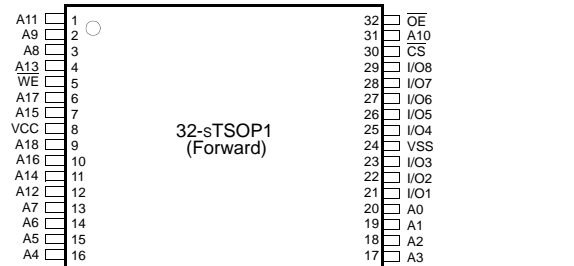
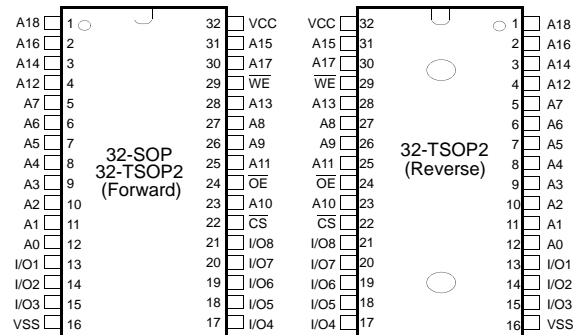
The K6X4008T1F families are fabricated by SAMSUNG's advanced full CMOS process technology. The families support various operating temperature range and have various package types for user flexibility of system design. The families also support low data retention voltage for battery back-up operation 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) | | 30μA | | | |

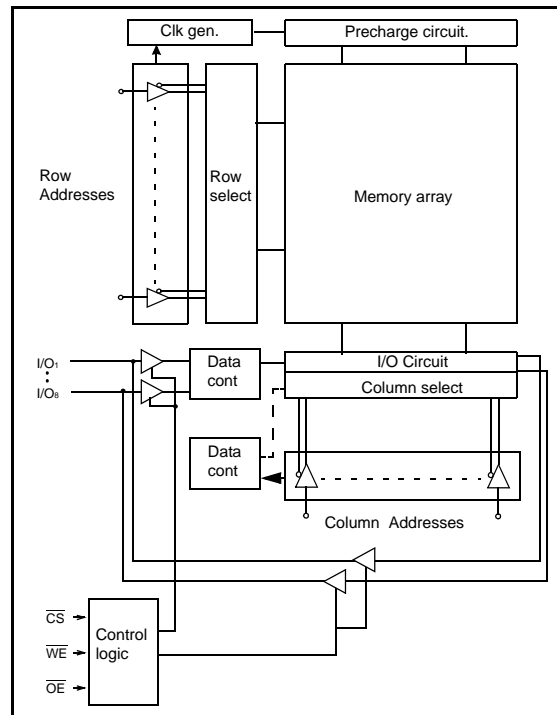
1. This parameter is measured in the voltage range of 3.0V~3.6V with 30pF test load.
2. This parameter is measured with 30pF test load.

PIN DESCRIPTION



| Name | Function | Name | Function |
|-----------------|---------------------|-----------|---------------------|
| A0~A18 | Address Inputs | Vcc | Power |
| \overline{WE} | Write Enable Input | Vss | Ground |
| \overline{CS} | Chip Select Input | I/O1~I/O8 | Data Inputs/Outputs |
| \overline{OE} | Output Enable Input | | |

FUNCTIONAL BLOCK DIAGRAM



SAMSUNG ELECTRONICS CO., LTD. reserves the right to change products and specifications without notice.

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⁾ | 32-SOP, 55ns | K6X4008T1F-GF55 ¹⁾ | 32-SOP, 55ns | K6X4008T1F-GQ70 | 32-SOP, 70ns |
| K6X4008T1F-GB70 | 32-SOP, 70ns | K6X4008T1F-GF70 | 32-SOP, 70ns | K6X4008T1F-GQ85 | 32-SOP, 85ns |
| K6X4008T1F-GB85 | 32-SOP, 85ns | K6X4008T1F-GF85 | 32-SOP, 85ns | K6X4008T1F-BQ70 | 32-SOP, 70ns, L/F |
| K6X4008T1F-BB55 ¹⁾ | 32-SOP, 55ns, L/F2) | K6X4008T1F-BF55 ¹⁾ | 32-SOP, 55ns, L/F | K6X4008T1F-BQ85 | 32-SOP, 85ns, L/F |
| K6X4008T1F-BB70 | 32-SOP, 70ns, L/F | K6X4008T1F-BF70 | 32-SOP, 70ns, L/F | K6X4008T1F-YQ70 | 32-sTSOP1-F, 70ns |
| K6X4008T1F-BB85 | 32-SOP, 85ns, L/F | K6X4008T1F-BF85 | 32-SOP, 85ns, L/F | K6X4008T1F-YQ85 | 32-sTSOP1-F, 85ns |
| K6X4008T1F-YB55 ¹⁾ | 32-sTSOP1-F, 55ns | K6X4008T1F-YF55 ¹⁾ | 32-sTSOP1-F, 55ns | K6X4008T1F-LQ70 | 32-sTSOP1-F, 70ns, L/F |
| K6X4008T1F-YB70 | 32-sTSOP1-F, 70ns | K6X4008T1F-YF70 | 32-sTSOP1-F, 70ns | K6X4008T1F-LQ85 | 32-sTSOP1-F, 85ns, L/F |
| K6X4008T1F-YB85 | 32-sTSOP1-F, 85ns | K6X4008T1F-YF85 | 32-sTSOP1-F, 85ns | K6X4008T1F-VQ70 | 32-TSOP2-F, 70ns |
| K6X4008T1F-LB55 ¹⁾ | 32-sTSOP1-F, 55ns, L/F | K6X4008T1F-LF55 ¹⁾ | 32-sTSOP1-F, 55ns, L/F | K6X4008T1F-VQ85 | 32-TSOP2-F, 85ns |
| K6X4008T1F-LB70 | 32-sTSOP1-F, 70ns, L/F | K6X4008T1F-LF70 | 32-sTSOP1-F, 70ns, L/F | K6X4008T1F-UQ70 | 32-TSOP2-F, 70ns, L/F |
| K6X4008T1F-LB85 | 32-sTSOP1-F, 85ns, L/F | K6X4008T1F-LF85 | 32-sTSOP1-F, 85ns, L/F | K6X4008T1F-UQ85 | 32-TSOP2-F, 85ns, L/F |
| K6X4008T1F-VB55 ¹⁾ | 32-TSOP2-F, 55ns | K6X4008T1F-VF55 ¹⁾ | 32-TSOP2-F, 55ns | | |
| K6X4008T1F-VB70 | 32-TSOP2-F, 70ns | K6X4008T1F-VF70 | 32-TSOP2-F, 70ns | | |
| K6X4008T1F-VB85 | 32-TSOP2-F, 85ns | K6X4008T1F-VF85 | 32-TSOP2-F, 85ns | | |
| K6X4008T1F-UB55 ¹⁾ | 32-TSOP2-F, 55ns, L/F | K6X4008T1F-UF55 ¹⁾ | 32-TSOP2-F, 55ns, L/F | | |
| K6X4008T1F-UB70 | 32-TSOP2-F, 70ns, L/F | K6X4008T1F-UF70 | 32-TSOP2-F, 70ns, L/F | | |
| K6X4008T1F-UB85 | 32-TSOP2-F, 85ns, L/F | K6X4008T1F-UF85 | 32-TSOP2-F, 85ns, L/F | | |
| K6X4008T1F-MB55 ¹⁾ | 32-TSOP2-R, 55ns | K6X4008T1F-MF55 ¹⁾ | 32-TSOP2-R, 55ns | | |
| K6X4008T1F-MB70 | 32-TSOP2-R, 70ns | K6X4008T1F-MF70 | 32-TSOP2-R, 70ns | | |
| K6X4008T1F-MB85 | 32-TSOP2-R, 85ns | K6X4008T1F-MF85 | 32-TSOP2-R, 85ns | | |
| K6X4008T1F-QB55 ¹⁾ | 32-TSOP2-R, 55ns, L/F | K6X4008T1F-QF55 ¹⁾ | 32-TSOP2-R, 55ns, L/F | | |
| K6X4008T1F-QB70 | 32-TSOP2-R, 70ns, L/F | K6X4008T1F-QF70 | 32-TSOP2-R, 70ns, L/F | | |
| K6X4008T1F-QB85 | 32-TSOP2-R, 85ns, L/F | K6X4008T1F-QF85 | 32-TSOP2-R, 85ns, L/F | | |

1. Operating voltage range is 3.0V~3.6V
2. L/F : Lead Free Package

FUNCTIONAL DESCRIPTION

| CS | OE | 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 RATINGS¹⁾

| 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 CONDITIONS¹⁾

| Item | Symbol | Min | Typ | Max | Unit |
|--------------------|-----------------|--------------------|---------|------------------------------------|------|
| Supply voltage | V _{CC} | 2.7 | 3.0/3.3 | 3.6 | V |
| Ground | V _{SS} | 0 | 0 | 0 | V |
| Input high voltage | V _{IH} | 2.2 | - | V _{CC} +0.2 ²⁾ | V |
| Input low voltage | V _{IL} | -0.2 ³⁾ | - | 0.6 | V |

Note:

- 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
- Overshoot: V_{CC}+2.0V in case of pulse width ≤ 30ns
- Undershoot: -2.0V in case of pulse width ≤ 30ns
- Overshoot and undershoot are sampled, not 100% tested.

CAPACITANCE¹⁾ (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

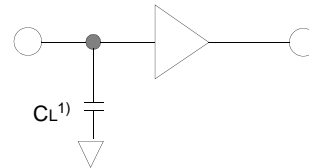
| Item | Symbol | Test Conditions | Min | Typ | Max | Unit | |
|--------------------------------|------------------|---|--------------|-----|-----|------|----|
| Input leakage current | I _{LI} | V _{IN} =V _{SS} to V _{CC} | -1 | - | 1 | μA | |
| Output leakage current | I _{LO} | $\overline{CS}=V_{IH}$ or $\overline{OE}=V_{IH}$ or $\overline{WE}=V_{IL}$ V _{IO} =V _{SS} to V _{CC} | -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 $\overline{CS} \leq 0.2V$, V _{IN} ≤0.2V or V _{IN} ≥V _{CC} -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} | $\overline{CS} \geq V_{CC}-0.2V$, Other inputs=0~V _{CC} | K6X4008T1F-B | - | - | 10 | μA |
| | | | K6X4008T1F-F | - | - | 10 | μA |
| | | | K6X4008T1F-Q | - | - | 30 | 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): $C_L=100\text{pF}+1\text{TTL}$
 $C_L^{(1)}=30\text{pF}+1\text{TTL}$

1. 55ns, 70ns product



1. Including scope and jig capacitance

AC CHARACTERISTICS

($V_{CC}=2.7\sim 3.6\text{V}$, 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.

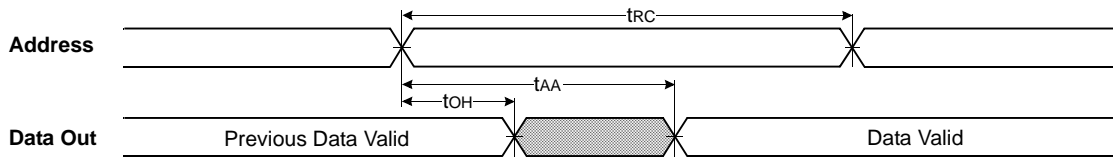
DATA RETENTION CHARACTERISTICS

| Item | Symbol | Test Condition | Min | Typ ¹⁾ | Max | Unit | |
|------------------------------------|-------------------|---|--------------|-------------------|-----|------|----|
| V _{CC} for data retention | V _D R | $\overline{CS} \geq V_{CC}-0.2\text{V}$ | 2.0 | - | 3.6 | V | |
| Data retention current | I _D R | $V_{CC}=3.0\text{V}, \overline{CS} \geq V_{CC}-0.2\text{V}$ | K6X4008T1F-B | - | 0.5 | 10 | μA |
| | | | K6X4008T1F-F | - | | 10 | μA |
| | | | K6X4008T1F-Q | - | | 30 | μA |
| Data retention set-up time | t _S DR | See data retention waveform | 0 | - | - | ms | |
| Recovery time | t _R DR | | 5 | - | - | | |

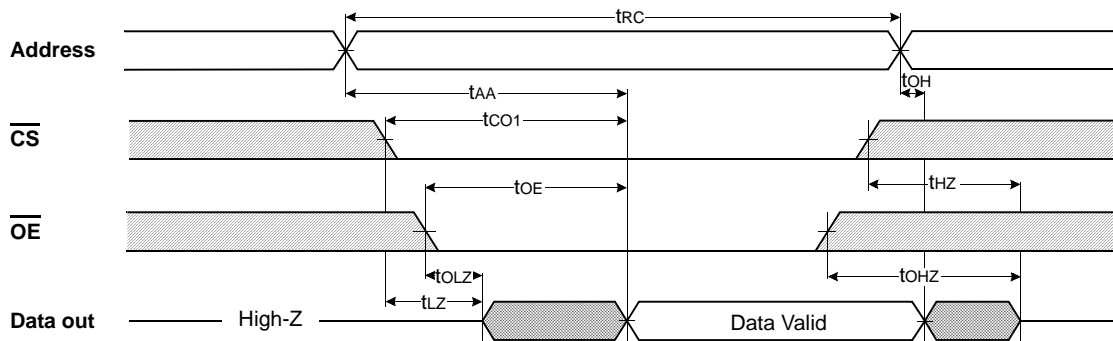
1. Typical values are measured at $T_A = 25^\circ\text{C}$ and not 100% tested.

TIMING DIAGRAMS

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



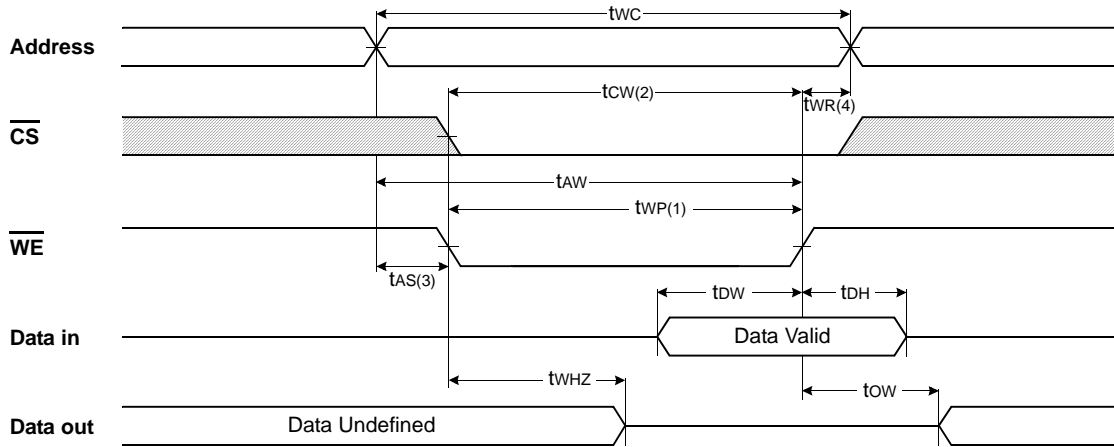
TIMING WAVEFORM OF READ CYCLE(2) ($\overline{WE}=V_{IH}$)



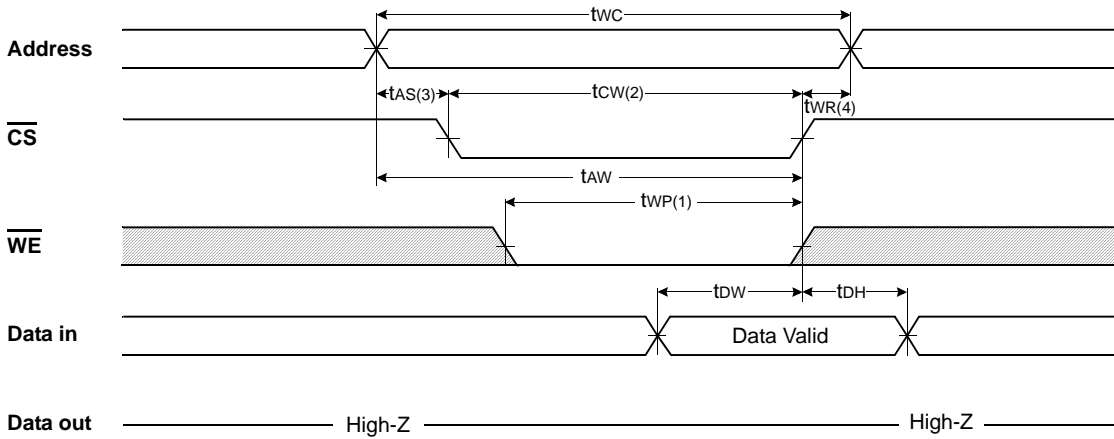
NOTES (READ CYCLE)

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, $t_{HZ}(\text{Max.})$ is less than $t_{LZ}(\text{Min.})$ 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)

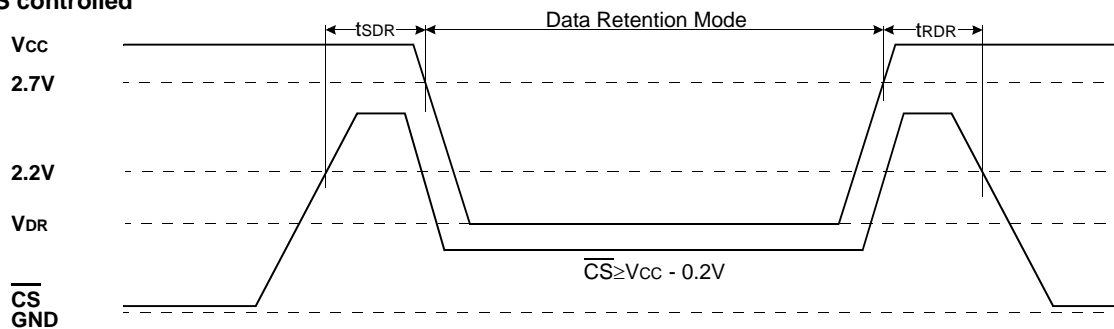


NOTES (WRITE CYCLE)

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 CS going high and WE going high, 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 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

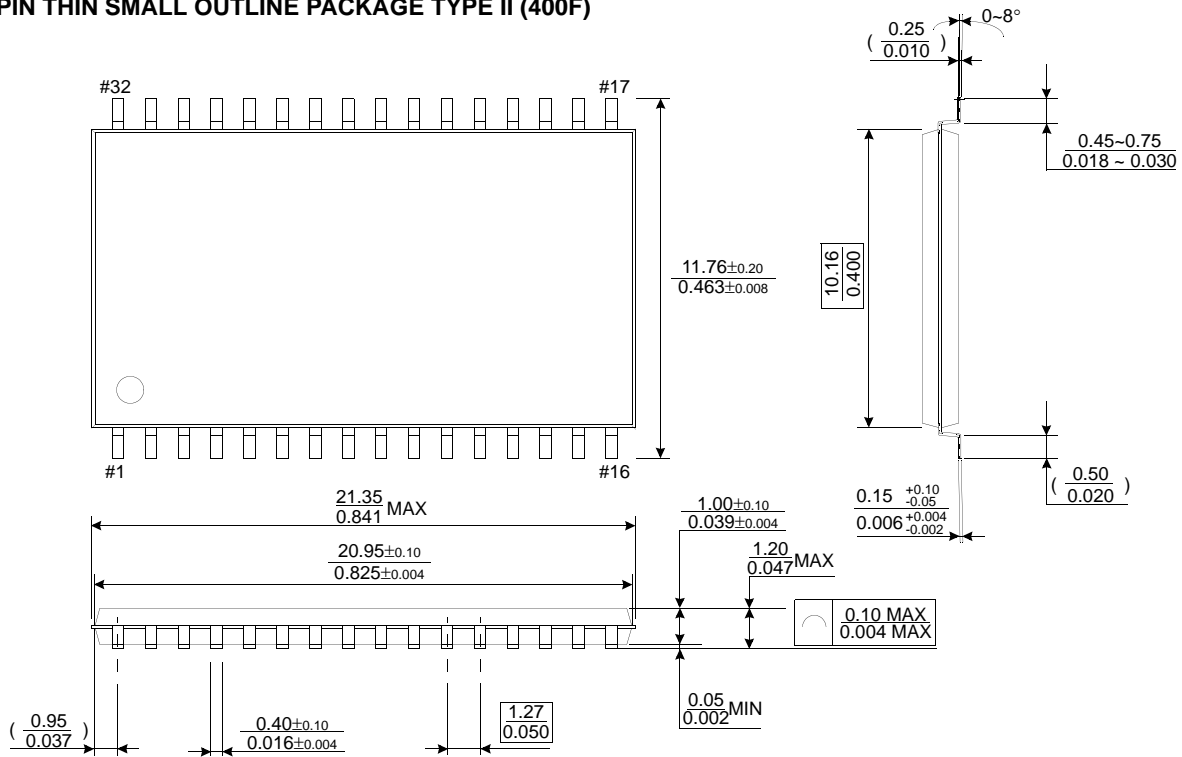
\overline{CS} controlled



PACKAGE DIMENSIONS

Units: millimeters(inches)

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



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

