

## Document Title

32Kx8 bit Low Power CMOS Static RAM

## Revision History

| <u>Revision No.</u> | <u>History</u>                                                                                                                                                                                                                                                            | <u>Draft Data</u> | <u>Remark</u> |
|---------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|---------------|
| 0.0                 | Initial draft                                                                                                                                                                                                                                                             | October 09, 2002  | Preliminary   |
| 1.0                 | Finalized<br>- Changed Icc from 10mA to 5mA<br>- Changed Icc1 from 8mA to 7mA<br>- Changed Icc2 from 35mA to 25mA<br>- Changed Isb from 3mA to 0.4mA<br>- Changed IdR for K6X0808C1D-F 15μA to 10μA<br>- Changed IdR for K6X0808C1D-Q 25μA to 20μA<br>- Errata correction | December 16, 2003 | Final         |

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## 32Kx8 bit Low Power full CMOS Static RAM

### FEATURES

- Process Technology: Full CMOS
- Organization: 32K x 8
- Power Supply Voltage: 4.5–5.5V
- Low Data Retention Voltage: 2V(Min)
- Three state output and TTL Compatible
- Package Type: 28-DIP-600B, 28-SOP-450,  
28-TSOP1-0813.4F/R

### GENERAL DESCRIPTION

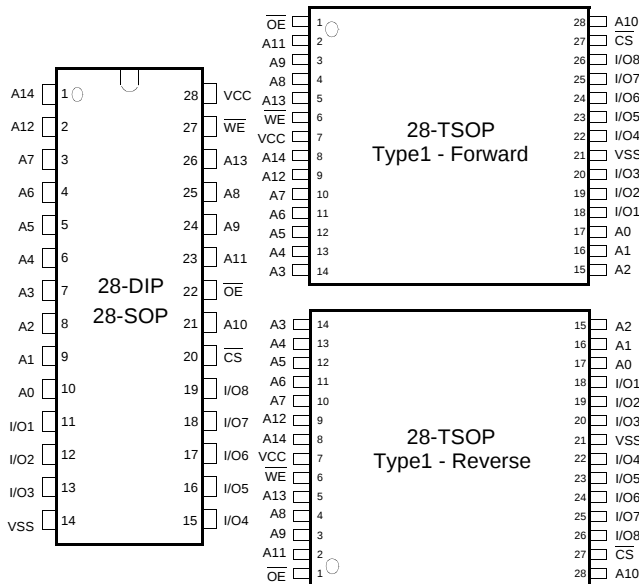
The K6X0808C1D families are fabricated by SAMSUNG's advanced CMOS process technology. The families support various operating temperature ranges and have various package types for user flexibility of system design. The families also support low data retention voltage for battery back-up operation with low data retention current.

### PRODUCT FAMILY

| Product Family | Operating Temperature | Vcc Range | Speed                  | Power Dissipation                |                                    | PKG Type                                       |
|----------------|-----------------------|-----------|------------------------|----------------------------------|------------------------------------|------------------------------------------------|
|                |                       |           |                        | Standby (I <sub>sb1</sub> , Max) | Operating (I <sub>cc2</sub> , Max) |                                                |
| K6X0808C1D-F   | Industrial(-40~85°C)  | 4.5–5.5V  | 55 <sup>1)</sup> /70ns | 15μA                             | 25mA                               | 28-DIP-600B, 28-SOP-450,<br>28-TSOP1-0813.4F/R |
| K6X0808C1D-Q   | Automotive(-40~125°C) |           |                        | 25μA                             |                                    | 28-SOP-450, 28-TSOP1-0813.4F                   |

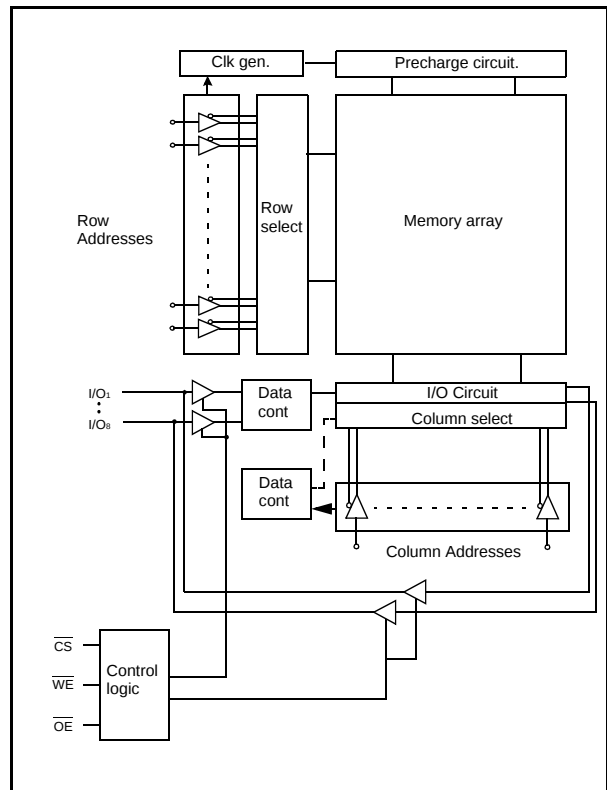
1. The parameters are tested with 50pF test load

### PIN DESCRIPTION



| Pin Name                        | Function            | Pin Name                           | Function            |
|---------------------------------|---------------------|------------------------------------|---------------------|
| $\overline{CS}$                 | Chip Select Input   | I/O <sub>1</sub> –I/O <sub>8</sub> | Data Inputs/Outputs |
| $\overline{OE}$                 | Output Enable Input | Vcc                                | Power               |
| $\overline{WE}$                 | Write Enable Input  | Vss                                | Ground              |
| A <sub>0</sub> –A <sub>14</sub> | Address Inputs      | NC                                 | No connect          |

### FUNCTIONAL BLOCK DIAGRAM



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## PRODUCT LIST

| Industrial Temp. Products(-40~85°C)                                                                                                                  |                                                                                                                                                                                                          | Automotive Temp. Products(-40~125°C)                                     |                                                                                                |
|------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------|------------------------------------------------------------------------------------------------|
| Part Name                                                                                                                                            | Function                                                                                                                                                                                                 | Part Name                                                                | Function                                                                                       |
| K6X0808C1D-DF55<br>K6X0808C1D-DF70<br>K6X0808C1D-GF55<br>K6X0808C1D-GF70<br>K6X0808C1D-TF55<br>K6X0808C1D-TF70<br>K6X0808C1D-RF55<br>K6X0808C1D-RF70 | 28-DIP, 55ns, LL Pwr<br>28-DIP, 70ns, LL Pwr<br>28-SOP, 55ns, LL Pwr<br>28-SOP, 70ns, LL Pwr<br>28-TSOP-F, 55ns, LL Pwr<br>28-TSOP-F, 70ns, LL Pwr<br>28-TSOP-R, 55ns, LL Pwr<br>28-TSOP-R, 70ns, LL Pwr | K6X0808C1D-GQ55<br>K6X0808C1D-GQ70<br>K6X0808C1D-TQ55<br>K6X0808C1D-TQ70 | 28-SOP, 55ns, L Pwr<br>28-SOP, 70ns, L Pwr<br>28-TSOP-F, 55ns, L Pwr<br>28-TSOP-F, 70ns, L Pwr |

## FUNCTIONAL DESCRIPTION

| $\overline{\text{CS}}$ | $\overline{\text{OE}}$ | $\overline{\text{WE}}$ | I/O    | Mode            | Power   |
|------------------------|------------------------|------------------------|--------|-----------------|---------|
| H                      | X <sup>1)</sup>        | X <sup>1)</sup>        | High-Z | Deselected      | Standby |
| L                      | H                      | H                      | High-Z | Output Disabled | Active  |
| L                      | L                      | H                      | Dout   | Read            | Active  |
| L                      | X <sup>1)</sup>        | L                      | Din    | Write           | Active  |

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

ABSOLUTE MAXIMUM RATINGS<sup>1)</sup>

| Item                                  | Symbol                             | Ratings                                  | Unit | Remark       |
|---------------------------------------|------------------------------------|------------------------------------------|------|--------------|
| Voltage on any pin relative to Vss    | V <sub>IN</sub> , V <sub>OUT</sub> | -0.5 to V <sub>CC</sub> +0.5V(Max. 7.0V) | V    | -            |
| Voltage on Vcc supply relative to Vss | V <sub>CC</sub>                    | -0.3 to 7.0                              | V    | -            |
| Power Dissipation                     | P <sub>D</sub>                     | 1.0                                      | W    | -            |
| Storage temperature                   | T <sub>STG</sub>                   | -65 to 150                               | °C   | -            |
| Operating Temperature                 | T <sub>A</sub>                     | -40 to 85                                | °C   | K6X0808C1D-F |
|                                       |                                    | -40 to 125                               | °C   | K6X0808C1D-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<sup>1)</sup>

| Item               | Symbol          | Min                | Typ | Max                                | Unit |
|--------------------|-----------------|--------------------|-----|------------------------------------|------|
| Supply voltage     | V <sub>CC</sub> | 4.5                | 5.0 | 5.5                                | V    |
| Ground             | V <sub>SS</sub> | 0                  | 0   | 0                                  | V    |
| Input high voltage | V <sub>IH</sub> | 2.2                | -   | V <sub>CC</sub> +0.5 <sup>2)</sup> | V    |
| Input low voltage  | V <sub>IL</sub> | -0.5 <sup>3)</sup> | -   | 0.8                                | V    |

Note:

1. Industrial Product: T<sub>A</sub>=-40 to 85°C, Otherwise specified  
Automotive Product: T<sub>A</sub>=-40 to 125°C, Otherwise specified
2. Overshoot: V<sub>CC</sub>+3.0V in case of pulse width≤30ns.
3. Undershoot: -3.0V in case of pulse width≤30ns.
4. Overshoot and undershoot are sampled, not 100% tested.

CAPACITANCE<sup>1)</sup> (f=1MHz, T<sub>A</sub>=25°C)

| Item                     | Symbol          | Test Condition      | Min | Max | Unit |
|--------------------------|-----------------|---------------------|-----|-----|------|
| Input capacitance        | C <sub>IN</sub> | V <sub>IN</sub> =0V | -   | 8   | pF   |
| Input/Output capacitance | C <sub>IO</sub> | V <sub>IO</sub> =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 <sub>LI</sub>  | V <sub>IN</sub> =V <sub>SS</sub> to V <sub>CC</sub>                                                                                                            | -1           | -   | 1   | μA   |    |
| Output leakage current         | I <sub>LO</sub>  | $\overline{CS}$ =V <sub>IH</sub> or $\overline{OE}$ =V <sub>IH</sub> or $\overline{WE}$ =V <sub>IL</sub> , V <sub>IO</sub> =V <sub>SS</sub> to V <sub>CC</sub> | -1           | -   | 1   | μA   |    |
| Operating power supply current | I <sub>CC</sub>  | I <sub>IO</sub> =0mA, $\overline{CS}$ =V <sub>IL</sub> , V <sub>IN</sub> =V <sub>IH</sub> or V <sub>IL</sub> , Read                                            | -            | -   | 5   | mA   |    |
| Average operating current      | I <sub>CC1</sub> | Cycle time=1μs, 100% duty, I <sub>IO</sub> =0mA, $\overline{CS}$ ≤0.2V, V <sub>IN</sub> ≤0.2V <sub>IN</sub> ≥V <sub>CC</sub> -0.2V                             | -            | -   | 7   | mA   |    |
|                                | I <sub>CC2</sub> | Cycle time=Min,100% duty, I <sub>IO</sub> =0mA, $\overline{CS}$ =V <sub>IL</sub> , V <sub>IN</sub> =V <sub>IH</sub> or V <sub>IL</sub>                         | -            | -   | 25  | mA   |    |
| Output low voltage             | V <sub>OL</sub>  | I <sub>OL</sub> =2.1mA                                                                                                                                         | -            | -   | 0.4 | V    |    |
| Output high voltage            | V <sub>OH</sub>  | I <sub>OH</sub> =-1.0mA                                                                                                                                        | 2.4          | -   | -   | V    |    |
| Standby Current(TTL)           | I <sub>SB</sub>  | $\overline{CS}$ =V <sub>IH</sub> , Other inputs=V <sub>IH</sub> or V <sub>IL</sub>                                                                             | -            | -   | 0.4 | mA   |    |
| Standby Current (CMOS)         | I <sub>SB1</sub> | $\overline{CS}$ ≥V <sub>CC</sub> -0.2V, Other inputs=0~V <sub>CC</sub>                                                                                         | K6X0808C1D-F | -   | -   | 15   | μA |
|                                |                  |                                                                                                                                                                | K6X0808C1D-Q | -   | -   | 25   | μA |

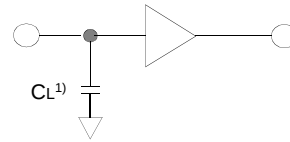
## AC OPERATING CONDITIONS

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

Input pulse level: 0.8 to 2.4V

Input rising and falling time: 5ns

Input and output reference voltage: 1.5V

Output load (See right):  $C_L=100\text{pF}+1\text{TTL}$  $C_L=50\text{pF}+1\text{TTL}$ 

1. Including scope and jig capacitance

AC CHARACTERISTICS ( $V_{CC}=4.5\sim 5.5\text{V}$ , Commercial product:  $T_A=0$  to  $70^\circ\text{C}$ , Industrial product:  $T_A=-40$  to  $85^\circ\text{C}$ )

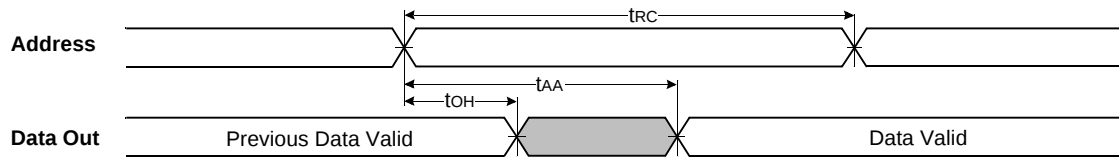
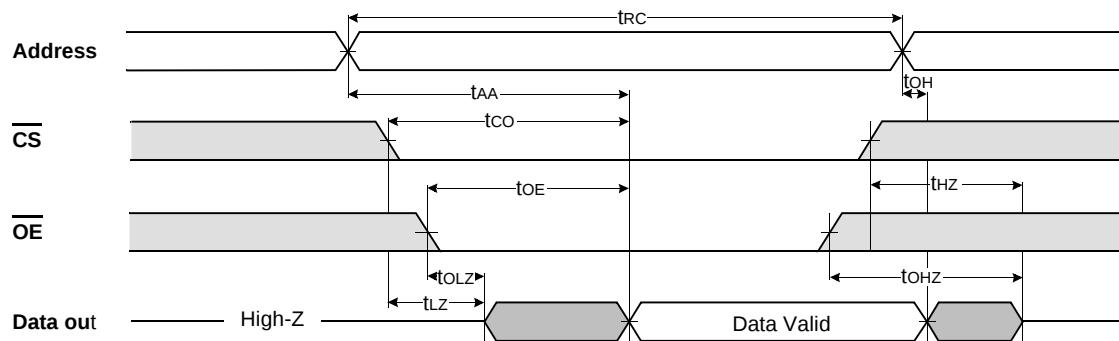
| Parameter List |                                 | Symbol           | Speed Bins          |     |      |     | Units |
|----------------|---------------------------------|------------------|---------------------|-----|------|-----|-------|
|                |                                 |                  | 55 <sup>1)</sup> ns |     | 70ns |     |       |
|                |                                 |                  | Min                 | Max | Min  | Max |       |
| Read           | Read cycle time                 | t <sub>RC</sub>  | 55                  | -   | 70   | -   | ns    |
|                | Address access time             | t <sub>AA</sub>  | -                   | 55  | -    | 70  | ns    |
|                | Chip select to output           | t <sub>CO</sub>  | -                   | 55  | -    | 70  | ns    |
|                | Output enable to valid output   | t <sub>OE</sub>  | -                   | 25  | -    | 35  | ns    |
|                | Chip select to low-Z output     | t <sub>LZ</sub>  | 10                  | -   | 10   | -   | ns    |
|                | Output enable to low-Z output   | t <sub>OLZ</sub> | 5                   | -   | 5    | -   | ns    |
|                | Chip disable to high-Z output   | t <sub>HZ</sub>  | 0                   | 20  | 0    | 30  | ns    |
|                | Output disable to high-Z output | t <sub>OHZ</sub> | 0                   | 20  | 0    | 30  | ns    |
|                | Output hold from address change | t <sub>OH</sub>  | 10                  | -   | 10   | -   | ns    |
| Write          | Write cycle time                | t <sub>WC</sub>  | 55                  | -   | 70   | -   | ns    |
|                | Chip select to end of write     | t <sub>CW</sub>  | 45                  | -   | 60   | -   | ns    |
|                | Address set-up time             | t <sub>AS</sub>  | 0                   | -   | 0    | -   | ns    |
|                | Address valid to end of write   | t <sub>AW</sub>  | 45                  | -   | 60   | -   | ns    |
|                | Write pulse width               | t <sub>WP</sub>  | 40                  | -   | 50   | -   | ns    |
|                | Write recovery time             | t <sub>WR</sub>  | 0                   | -   | 0    | -   | ns    |
|                | Write to output high-Z          | t <sub>WHZ</sub> | 0                   | 20  | 0    | 25  | ns    |
|                | Data to write time overlap      | t <sub>DW</sub>  | 25                  | -   | 30   | -   | ns    |
|                | Data hold from write time       | t <sub>DH</sub>  | 0                   | -   | 0    | -   | ns    |
|                | End write to output low-Z       | t <sub>OW</sub>  | 5                   | -   | 5    | -   | ns    |

1. The parameter is tested with 50pF test load.

## DATA RETENTION CHARACTERISTICS

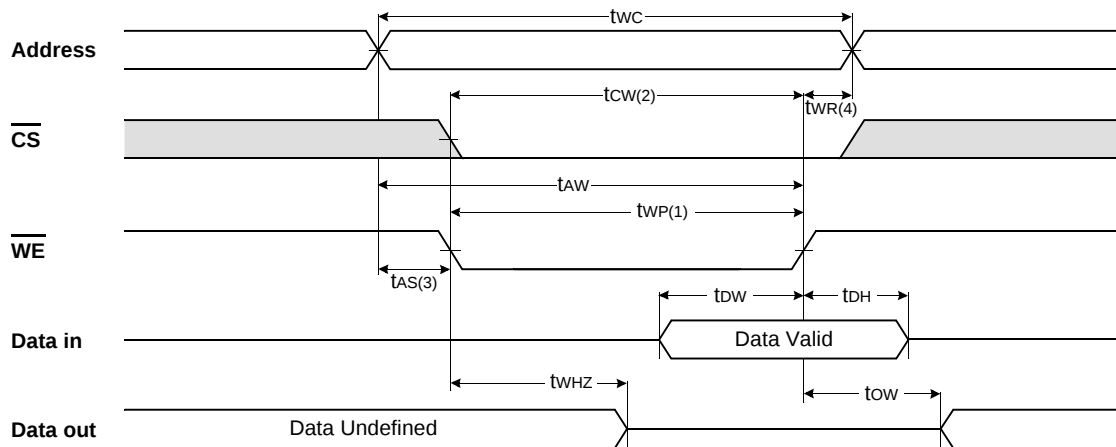
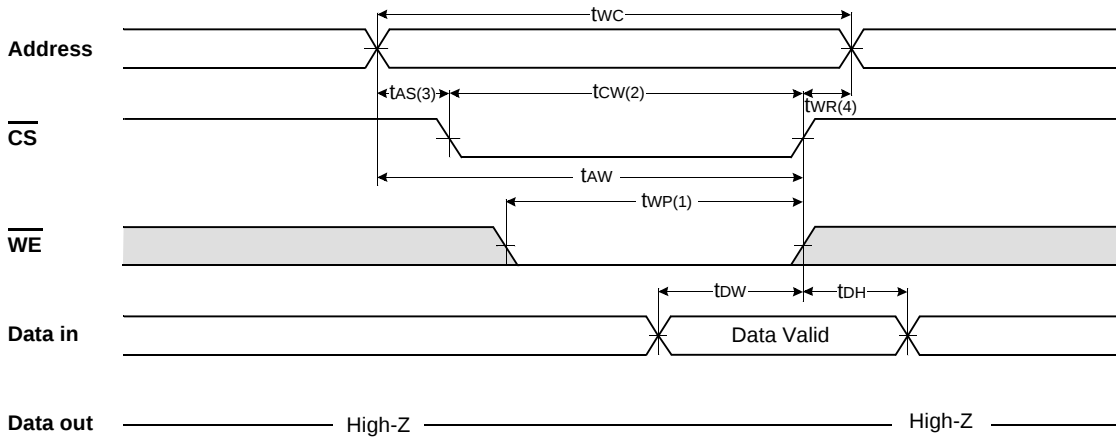
| Item                               | Symbol           | Test Condition                                              |              | Min | Typ | Max | Unit          |
|------------------------------------|------------------|-------------------------------------------------------------|--------------|-----|-----|-----|---------------|
| V <sub>CC</sub> for data retention | V <sub>DR</sub>  | $\overline{CS} \geq V_{CC}-0.2\text{V}$                     |              | 2.0 | -   | 5.5 | V             |
| Data retention current             | I <sub>DR</sub>  | $V_{CC}=3.0\text{V}, \overline{CS} \geq V_{CC}-0.2\text{V}$ | K6X0808C1D-F | -   | -   | 10  | $\mu\text{A}$ |
|                                    |                  |                                                             | K6X0808C1D-Q | -   | -   | 20  |               |
| Data retention set-up time         | t <sub>SDR</sub> | See data retention waveform                                 |              | 0   | -   | -   | ms            |
| Recovery time                      | t <sub>RDR</sub> |                                                             |              | 5   | -   | -   |               |

## 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)

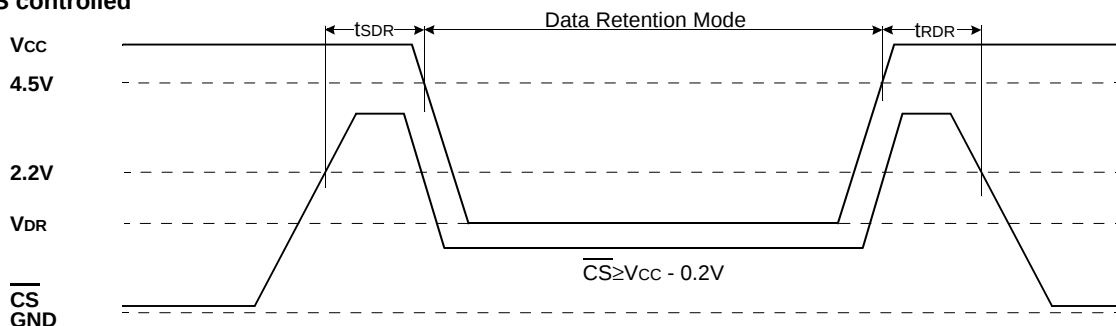
1.  $t_{HZ}$  and  $t_{OHZ}$  are defined as the time at which the outputs achieve the open circuit conditions and are not referenced to output voltage levels.
2. At any given temperature and voltage condition,  $t_{HZ}(\text{Max.})$  is less than  $t_{LZ}(\text{Min.})$  both for a given device and from 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 ends at the earliest transition among  $\overline{CS}$  going high and  $\overline{WE}$  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.  $t_{WR}$  applied in case a write ends as  $\overline{CS}$  or  $\overline{WE}$  going high.

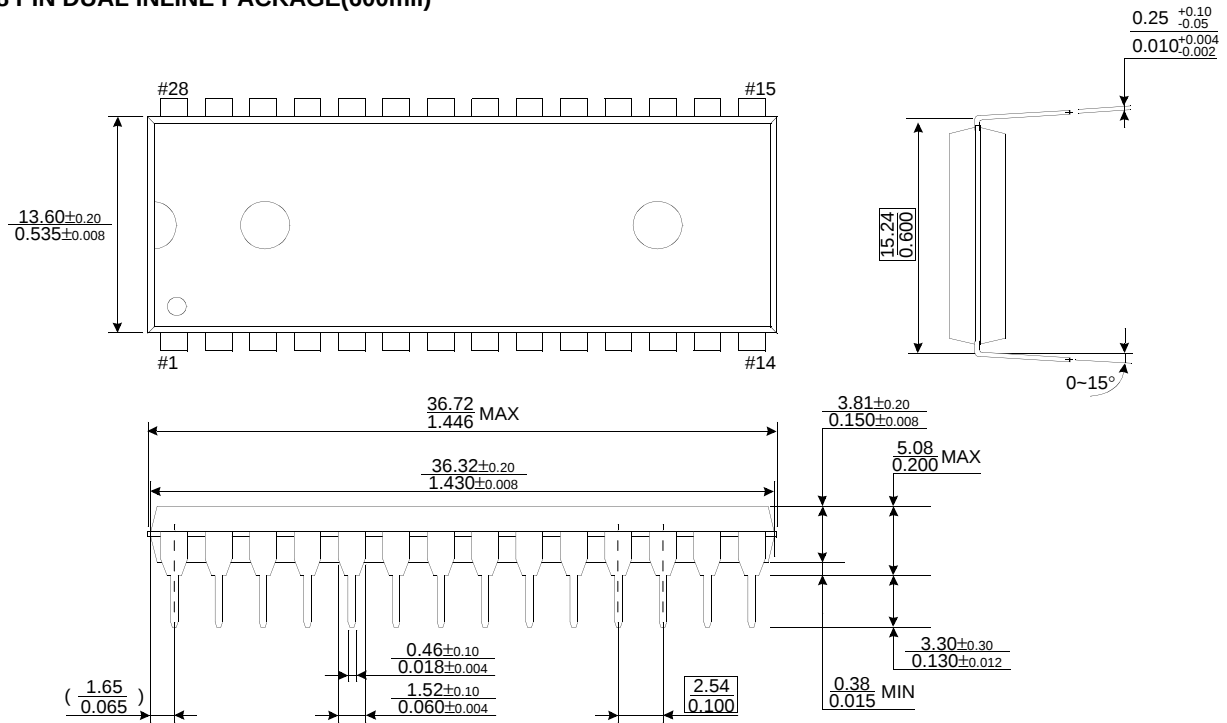
## DATA RETENTION WAVE FORM

 $\overline{CS}$  controlled

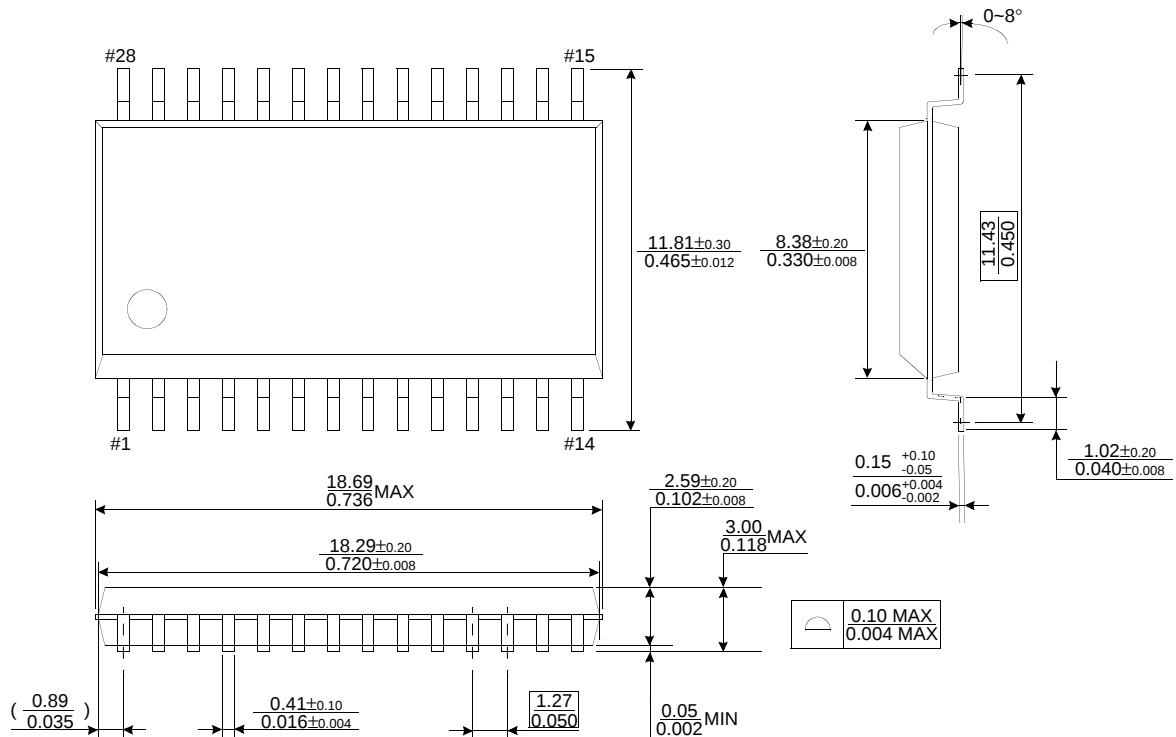
## PACKAGE DIMENSIONS

Units: millimeter(inch)

### 28 PIN DUAL INLINE PACKAGE(600mil)



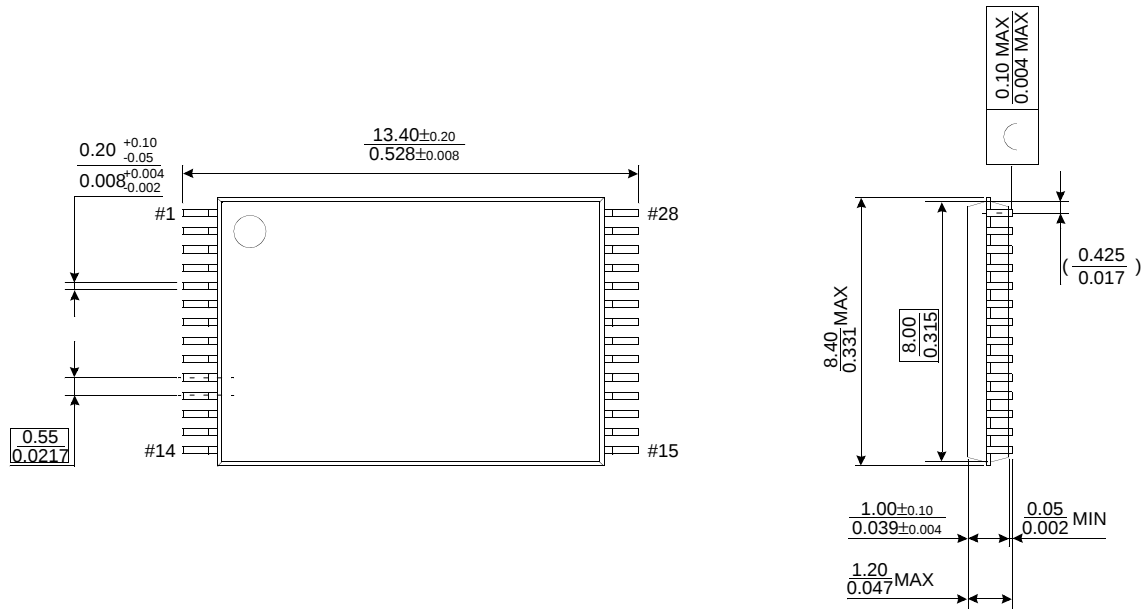
### 28 PIN PLASTIC SMALL OUTLINE PACKAGE(450mil)



## PACKAGE DIMENSIONS

Units: millimeter(inch)

### 28 PIN THIN SMALL OUTLINE PACKAGE TYPE I (0813.4F)



### 28 PIN THIN SMALL OUTLINE PACKAGE TYPE I (0813.4R)

